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*THE PROPOSED NATIONAL UNIVERSITY.**

THE paper by Hon. Chas. D. Walcott, Director of the U. S. Geological Survey, published in SCIENCE for June 28, 1901, then issued in a separate pamphlet, and now kindly brought to my notice by the author, disposes of the National University movement in the following summary manner:

> But Congress has always looked on the scheme with suspicion, and not one of the various bills offered was ever acted upon by the Senate and House of Representatives. The trend of opinion has been and is that the Government should not found a National University in the sense suggested by Washington and his followers.

At first I thought to let these statements pass without notice, believing that in course of time they would correct themselves. But on reflection I conclude to make a comprehensive review of them, as also some comments on the 'Memorial' scheme so fully set forth in connection therewith, and finally to point out some of the special functions of the proposed National University which so deeply concerned Washington, but which seem never to have been duly considered by those now engaged in promoting an enterprise which its projectors intend shall defeat the establishment of such university altogether.

* A review of Hon. Chas. D. Walcott's paper on 'Relations of the General Government to Higher Education and Research.'

ATTITUDE OF CONGRESS.

Of the non-passage of bills I will speak further on. Let us, first of all, see how far this declaration concerning the attitude of Congress accords with the real facts in the case.

To begin with the House, the only action ever taken by that body on the subject of a national university was affirmative and unanimous. The National Educational Association, having first by a unanimous vote, at Trenton, N. J., in 1869, declared a great American university to be 'a leading want of American education,' and appointed a 'committee consisting of one member from each of the States * * * to take the whole matter under consideration,' and to report thereon, and having twice unanimously adopted the affirmative reports of said committee (at Cleveland, in 1870, and at St. Louis, in 1871), then by unanimous vote created a permanent committee to prepare and offer to Congress a bill to establish a national university.

The committee embraced, besides the chairman, Ex-President Thomas Hill, of Harvard; Editor Godkin, of *The Nation;* State Superintendent Wickersham, of Pennsylvania; Dr. Barnas Sears, of Virginia; Col. D. F. Boyd, President of the University of Louisiana; President Daniel Read, of the University of Missouri; Dr. W. F. Phelps, President State Normal School, Winona, Minnesota; Ex-Governor A. C. Gibbs, of Oregon; Hon. Newton Bateman, Superintendent of Public Instruction of Illinois; Superintendent Emerson E. White, President-elect of the National Educational Association; General John Eaton, U. S. Commissioner of Education; Dr. Joseph Henry, Secretary of the Smithsonian Institution and President of the National Academy of Sciences; Dr. J. Lawrence Smith, of Kentucky, President of the American Association for the Advancement of Science; and Dr. Samuel Elliot, of Connecticut, President of the American Social Science Association.

The bill prepared by these men was introduced in the House during the last session of the 42nd Congress and referred to the Committee on Education, of which Chairman Perce, of Mississippi, and Mr. Hoar, of Massachusetts, were prominent members, and near the end of the said session was unanimously returned to the House with a strong report, of which the following is the closing passage:

> If, then, it be true, as the committee has briefly endeavored to show, that our country is at present wanting in the facilities essential to the highest culture in many departments of learning; and if it be true that a central university, besides meeting this demand, would quicken, strengthen and systematize the schools of the country from the lowest to the highest; that it would increase the amount and the love of pure learning, now so little appreciated by our people, and so improve the intellectual and social status of the nation; that it would tend to homogeneity of sentiment, and thus strengthen the unity and patriotism of the people; that by gathering at its seat distinguished savants, not only of our own but of other lands, it would eventually make our national capital the intellectual center of the world, and so help the United States to rank first and highest among the enlightened nations of the earth—then is it manifestly the duty of Congress to establish and amply endow such a university at the earliest possible day.
>
> The committee, therefore, affirm their approval of the bill, and recommend its passage by the House.

It is believed that the success of the university measure in some proper form then required only that uninterrupted attention which, unhappily, a change of circumstances rendered it impossible for its friends to give. The opinion of the National Educational Association, in favor of the establishment of a national university, was reaffirmed by unanimous vote at its annual meeting, held in Detroit, on August 6, 1874, and, as seen by its recent declarations, in the same place, has endured with the years.

2. In 1890, when Senator Geo. F. Ed-

munds introduced his 'Bill to establish the University of the United States,' and moved its reference to a special committee, no opposition was made. Had he retained his physical vigor, he would doubtless have made his chairmanship of the committee effective.

3. At the Senate's session of August 3, 1892, when Senator Proctor presented the 'Memorial in regard to a National University' by John W. Hoyt, and moved that it be printed and referred, Senator Sherman moved the further printing of 5,000 extra copies, which was ordered unanimously; also, that at a subsequent session other thousands of extra copies were ordered printed without objection.

4. Although at the opening of the 52nd Congress, Senator Proctor, whose interest was very positive, assumed the chairmanship, by request, he was occupied with important measures already in hand, and submitted his sterling and unanimous report so late in the Congress that other matters prevented its consideration. The committee was a strong one and would have been potential, could they early have taken it in hand, as they would have done a question of commerce, finance or war. The Senate was ready.

5. When the Senate 'Committee to establish the University of the United States' was made a 'standing' committee, there was no opposition to the change.

6. In the 53rd Congress, when Senator Hunton was chairman of the committee, he was so circumstanced that his able report (also unanimous) could not be prepared, submitted and supported, as it was, by his own and other able speeches, until the time had come when appropriation bills had the right of way, and a single negative vote could again prevent action by the Senate.

7. It was not until during the first session of the 54th Congress, when the determination of the executive council of the National University Committee had met with assurances of cooperation from all parts of the country, and the council, with the Chief Justice of the United States presiding and but one of its fifteen members absent, gave three protracted sessions to the framing of a new bill, that there appeared the first sign of opposition, either in or out of Congress.

The members of the executive council at that time were these:

The Honorable Melville W. Fuller, Chief Justice of the United States; Ex-U. S. Senator Geo. F. Edmunds, of Vermont; Dr. William Pepper, Ex-Provost of the University of Pennsylvania; Hon. Andrew D. White, Ex-President of Cornell University, Ambassador to Germany; Ex-Governor John Lee Carroll, of Maryland, General-President Society of Sons of the Revolution; General Horace Porter, President General Society of Sons of the American Revolution, Ambassador to France; Ex-U. S. Senator Eppa Hunton, of Virginia; Ex-U. S. Senator A. H. Garland, late Attorney-General of U. S.; Ex-U. S. Senator J. B. Henderson; Col. Wilbur R. Smith, of Kentucky University; Gen. John Eaton, Ex-U. S. Commissioner of Education; Hon. Gardiner G. Hubbard, President National Geographic Society; Professor Simon Newcomb, Director of the Nautical Almanac, U. S. N.; Hon. John A. Kasson, Ex-U. S. Minister to Austria and Germany; Hon. Oscar S. Strauss, Ex-U. S. Minister to Turkey; G. Brown Goode, Assistant Secretary Smithsonian Institution; Ex-Gov. John W. Hoyt, Chairman National University Committee. (In the places of Messrs. Pepper, Hubbard, Garland and Goode, since deceased, there are now: Hon. H. A. Herbert, Ex-Secretary of the Navy; Dr. S. P. Langley, Secretary of the Smithsonian Institution; Lieutenant-General Nelson A. Miles, commanding the Army.)

The bill was unanimously approved by

the other distinguished members of the National University Committee, and gave promise of early success. President David Starr Jordan, of Leland Stanford University, wrote, 'Put it through without the change of a punctuation point.' Its passage was advocated in person, before the Senate university committee, by ex-Senator Geo. F. Edmunds, ex-Provost William Pepper, of the University of Pennsylvania, Professor Simon Newcomb, General John Eaton, Hon. Gardiner G. Hubbard, Hon. John A. Kasson, ex Gov. John Lee Carroll, Hon. Andrew D. White and John W. Hoyt; and on March 10, 1896, Senator Kyle, chairman, submitted an affirmative report, with the said supporting arguments, and with over three hundred letters from members of the National University Committee, and other papers supporting the university proposition. It was an eminently satisfactory report of 156 printed pages, and for a time was supposed to be without dissent from any member. Adverse influences from denominational and other sources had been at work, however, so that a month later a brief minority report was submitted, with opposing letters from the presidents of Harvard, Yale, Columbia, and the University of Pennsylvania, and five or six small colleges, all denominational. Even with their friends it was beyond comprehension how the minority were willing to appear with so weak a showing.

For the rest, it is sufficient to say that the rule of courtesy which allowed the minority time to get ready, the printing of affirmative reports, and other causes, resulted in a postponement of action by the chairman of the Senate committee until the following session of Congress.

8. The 'Reply to Views of the Minority,' by the chairman of the National University Committee, when submitted to the Senate by Chairman Kyle, with many additional letters of indorsement from distinguished friends of the measure, was promptly received by the Senate and ordered printed.

9. At the opening of the second session of the 54th Congress, papers in support of the National University proposition, by Professor William H. H. Phillips, of South Dakota, and President David Starr Jordan, of Leland Stanford University, were, upon motion of Senator Kyle, ordered printed by the Senate, without dissent.

10. Before the Senate committee's report could be conveniently called up in the second session of the 54th Congress, Chairman Kyle was called to his distant home, and, although confidently expected from week to week, so that neither Senator Sherman, who was next on the committee list, nor any other member thought it fit to act in his stead, he did not actually return until within three days of the end of that Congress.

11. Upon the opening of the 55th Congress, the appointment of Senator Wellington, of Maryland, to the chairmanship was a surprise to the National University Committee, because of assurances touching the continuous and earnest work of Senator Kyle. It also proved to be without result; for, notwithstanding assurances from Chairman Wellington of his deep interest in the university cause and his purpose to do everything possible to further it, not even a meeting of his committee could be secured during the said Congress.

12. Notwithstanding these facts, coupled with the readiness of Senator Chauncey M. Depew, always a warm friend of the national university idea, to take the lead and carry the measure forward, Chairman Wellington (still in possession, under Senatorial usage), because of assurances of action, held over. And there was at last a meeting of the committee, during the first session of the 56th Congress, and an agreement, without dissent, upon the new bill offered by Senator Depew with the approval

of the National University Committee. A report was also made ready and, with one hundred additional letters (including those from Ex-President Benjamin Harrison, from ex-senators, heads of national organizations, and the presidents of sixty additional colleges and universities, beginning with the University of Virginia and embracing ten of the leading Methodist institutions), was at one time on Chairman Wellington's desk, in the Senate, for presentation. They were never submitted, however. And of course there were requests many, appeals many and promises many.

Such is a brief history of both Senatorial and committee action on the subject of a national university during the past few years. It proves unmistakably that the talk of 'suspicion' on the part of Congress is without so much as the shadow of a foundation—that there has been none but affirmative action from first to last; that Congress has in fact done everything that was ever asked of it or of either House; and that in nearly, if not in every, case such affirmative action has been prompt and unanimous. There have been trying delays, but those of the last decade are not chargeable to the Senate, but to individual members of its university committee. And it may not be improper to add that there were Senators not a few, and among the most active and influential, who were as emphatic in their expressions of disappointment at the obstructive course of a chairman chosen because of his declared friendly attitude, as were the members of the National Committee themselves.

'THE TREND OF OPINION.'

After the showing thus made of the friendly attitude of Congress, first, last and always; of the views of leading men of the nation in all the great pursuits, including the heads of all but five or six of the colleges and universities appealed to; and, last of all, the marked demonstration again made by the National Educational Association at Detroit, it is hardly worth while to spend a moment discussing the 'trend of public opinion.' Dr. Walcott should know that it 'has been and is, that the Government' *should* 'found a national university,' and that, too, 'in the sense suggested by Washington and his followers.' I mean in the broad sense, and for the accomplishment of the great ends he had in view. There have been such advances in science and such development of educational institutions since his day as he could not foresee, and as would necessitate a different sort of university work, in some respects, from that of his day, and yet not different in that it was to be, and is to be, the highest possible—and that, too, with help rather than hindrance of all other institutions, and with a fulfilment of special offices to which it alone would be competent, as I shall show at the end of this review. The Depew bill (last before the Senate), like its forerunners, makes sure of the national university's limitation to this high field.

OPPOSITION BECAUSE OF MISCONCEPTIONS.

There were, in 1896, a few opposing senators, but, since none of them have offered valid reasons for negative action (see 'Reply'), we are not without hope that they will yet concur. If they are endowers, graduates or patrons of some half-dozen leading universities, it is difficult to believe that on this account, and right here, in the midst of unparalleled facilities for a true university—facilities provided at a cost of some $40,000,000 to the whole people of the country, and maintained and utilized at a cost of several millions annually—they would be glad to prevent the establishment of an institution which would at once do honor to the nation and be a practical friend of their favorites. Surely any such senators will upon reflection come to agree

with the multitude of statesmen and scholars of a hundred years, the views of whom are so emphatically reaffirmed by Ambassador Andrew D. White, who just now again says, from Berlin: "It would in many ways make itself helpful to every school, college and university in the land"; and by President Harper, of the University of Chicago, when he wrote me not very long ago: "I have always believed in such an institution and will continue to believe in it. There is everything to be gained and nothing to be lost." They will see with Dr. Cattell, the able editor of SCIENCE, that "all the arguments which have been urged against the establishment of a national university turn out to be in its favor." Nay, more, it is hard to believe that any right-minded, unbiased senator or representative will fail at length to see that such an institution as is planned by the National University Committee would also serve to give the United States a new dignity and importance among the nations.

Under this head should also be embraced all friends of the national university movement who, whether they have done aught to advance it or not, or have inquired into the causes of delay, are now tired of waiting for the grand result, and have been induced to lend their influence to a scheme whose origination and inauguration have been with those who intend that it shall prevent the establishment of the university. They, too, will surely right themselves, when rightly informed.

Of course the hindrances common to great movements for intellectual advancement have not been wanting in this one; such as the extent to which legislators accounted the best are often absorbed in questions that concern industrial development, commerce, finance and international differences involving war—matters all of them so related, moreover, to the ascendency of political parties as at times to fill the whole field of vision; causes such as the growing passion for increase of wealth and power as means of supremacy among the nations, and which leave out of consideration the no less necessary and still higher conditions of a superior civilization; such, indeed, as lie in a spirit of denominational ambition, which in some of the churches is stronger than the spirit of religious freedom or anything else. And last of all, possibly in this case more serious than all others, there is the very nobleness of the national university idea, on account of which so many eminent and influential citizens, who should make themselves felt in every practicable manner, rest in the hope that every other friend of the pending measure will do his full duty, and themselves do little or nothing—in other words shift the responsibility on Providence, forgetting that Providence helps those who first help themselves, and that no great end is realized except through sacrifice.

OTHER OPPOSING FORCES.

Lastly, there are others, the grounds of whose opposition I will not even make a subject of conjecture, confining myself to a statement of facts of interest and to the pointing out of a few faults and the total insufficiency of the 'Memorial Institution.' The author of the paper under review was himself but lately interested in the national university, as will appear from his letter of December 20, 1894, which reads as follows:

"I fully believe in establishing such a university in the interest of higher education, and I cordially indorse the statements made by the late President James C. Welling, printed on pages 95-7 of your Memorial on the subject. The statements and views expressed in the Memorial are so exhaustive and comprehensive that I do not know that I could add to them, except to record my personal approval of the movement."

The following is an extract from President Welling's letter to which Dr. Walcott here refers:

"Such a university as I here prefigure would come into no rivalry with any existing institution under the control of any denomination. It would aim to be the crown and culmination of our State institutions, borrowing graduates from them and repaying its debt by contributing in turn the inspiration of high educational standards, and helping also in its measure to train the experts, * * * who should elsewhere strive to keep alive the traditions of a progressive scholarship. * * * It is not enough that our colleges should perpetuate and transmit the existing sum of human knowledge. We must have our workers on the boundaries of a progressive knowledge if we are to establish our hold on the directive forces of modern society."

It may be added that, within a very few months, Dr. Walcott, who is still a member of the National University Committee, avowedly shared the writer's indignation on account of delays, and expressed regret that he could not contribute more to the progress of the national university movement.

FAULTS OF THE 'MEMORIAL' SCHEME.

Now, while I have neither plan nor purpose to make war upon the 'Washington Memorial Institution,' and might never have said a word concerning it but for this strange attempt upon the life of the national university movement, it seems my duty, as the matter stands, to point out some reasons why the said 'Memorial Institution,' if established exactly as its friends would have it, is not likely to meet their expectations. I do so for the benefit in particular of such of its patriotic members as, being without time for a careful study of the whole subject, may have thought of it as a possible practical beginning of the national university in which they have believed.

In the first place it is to be regretted that, as devised and constituted, it is not better calculated to represent the ideas of him whom it affects to honor—that it is fragmentary and does not contemplate a final national university.

The friends and promoters of the national university movement had duly considered the question of making the best practicable beginning they could, on the scientific side, without waiting for direct Congressional authority, but soon concluded that it would be wiser to go forward and secure the desired Congressional action. The country had waited a hundred years and could wait a little longer. A proper charter then seemed within easy reach. A liberal charter is still bound to come, and at no distant day, now that the schemers have boldly thrown off the mask, on the one hand, and that the National Educational Association has again, for the fifth time, by an overwhelming vote, declared for a national university of the highest rank.

Secondly, Washington wanted a true university, for supreme work only, and for reasons first national, then universal, located at the national capital, and sustaining such relations to all other institutions and educational agencies of the country and to the government itself as would make it in a superior sense a stimulating and guiding, as well as elevating, force and influence for the universal good.

It is also such an institution as this that the truly patriotic people of the United States want to-day. Nothing less will ever satisfy, as the able advocacy of earnest men in all the past, the persistent efforts of the National University Committee, the liberal action of the U. S. Senate and the recent renewal of supporting declarations of the country's educators plainly show.

Passing these two considerations, ethical and patriotic, the scheme of the Memorial Institution is itself of a character to challenge serious criticism, as its originators will find when they come to a practical test.

According to Dr. Walcott, it is to be a private foundation, without Government support or control. But he also tells us: "The policy of the Government, as expressed, is to aid in higher education by granting [to the Washington Memorial Institution] the use of such facilities as are at its command in the District of Columbia"; and again, "The Government's part in the work of the Washington Memorial Institution, when once under successful headway, will be to enlarge the quarters of the various bureaus concerned." To be sure, he hastens to add: "This will be necessary eventually, even if no student assistants are provided for." But it is apparent that if the Memorial Institution is to utilize the Government's collections and facilities for scientific research at Washington, such collections and facilities, now inadequate to such utilization, must exceed the Government's own demands, and exceed them in proportion to the utilization by the Memorial Institution; in other words, that Congress must make constantly increasing appropriations for the benefit of the Memorial Institution. Indeed, this enlargement of Governmental collections and facilities at Washington is the very *sine qua non* of the Memorial Institution. Yet we are told the Memorial Institution is to be without Government support.

This is not all. The Memorial Institution is to be also independent of Government control, says Dr. Walcott. But he then goes on to inform us that the Cabinet and various other Government officials are largely to constitute the advisory board of the Memorial Institution, and that the character and extent of the student-assistants' work in the various departments of the Government is to be defined by the heads thereof, so that the same may be without detriment to the public service. And so, after all, there will be considerable opportunity and indeed necessity for Government control.

It thus appears that the Memorial Institution is to avail itself of the very assistance, and is to be subject to the same influence which its promoters condemn when proposed, to a less extent, in connection with a national university.

Other difficulties will present themselves after a little careful reflection; such as these, for example:

1. The three particular functions of the Memorial Institution—to ascertain and publish the opportunities for students in the Government Departments at Washington; to receive, enroll and direct such students to the places awaiting them; and to record their work and certify it, when requested, to any institution of learning—require no such widely scattered board of trustees as is provided, but could be as well, and indeed more effectively, performed by a small local committee. Unlike a national university, with plans and policies to be developed, the Memorial Institution begins with a fixed plan, whose operation will be largely subject to the dictation of the men whom the fortuities of politics have placed in charge of the Government Departments. The number and distribution of the board in question seem but a vain pretension to the nationality to which they are confessedly opposed.

2. The number of students of the Memorial Institution being limited (very limited, in the absence of Congressional appropriations), what is to prevent the institution in whose interest the Memorial Institutions was primarily worked up from having an undue share of student-assistant places? What is to safeguard the interests

of the four hundred or more colleges and universities of the country, by insuring them equitable representation in the opportunities which the Government provides and which the Memorial Institution proposes to dispense?

3. The Departments will not readily cooperate with a non-Governmental agency calculated to interfere with its own work.

4. If the Memorial Institution claims to provide opportunities for original research and investigation, it will sadly fail, for the Government does not carry on general scientific investigations, but confines itself to certain lines of work, which are not only special, but routine. If the Government expert himself cannot be an original, independent investigator, much less can the student-assistant.

5. The Memorial Institution repudiates the idea of instruction. Yet how will the investigations by its student-assistants, in scientific work, be carried on without instruction, and pretty systematic instruction, at that, to say nothing of any work it may attempt on lines not strictly scientific?

6. Even on the very limited lines proposed by the Memorial Institution, more money will be needed than such a concern is calculated to obtain from private sources. And how is the Memorial Institution to placate its Congressional patrons, when every student-assistant, especially if he becomes a Government fixture (and the Memorial Institution anticipates that a majority of them will remain in the Government service), closes the door to just so much Congressional patronage?

7. What shall be said of the ethics of an institution which encourages scientific work by students in the Departments at Washington as a means to the attainment of degrees at certain universities whose equipments are insufficient to such degrees? It has decidedly the appearance of giving credit where credit is not due, and will eventually discredit the institutions it favors by such means.

8. It is said that the *esprit du corps* so desirable in every student-body could not be developed by Congressional action, in connection with scientific investigations at Washington, because it would be 'a violent departure from all precedent,' and in the next breath we are told that this happy result has been obtained by the legislation of March 3, 1901, which nominally extended the utilization of the Government's scientific equipment at Washington to all the educational institutions of the country.

9. In view of the land-grant colleges and the U. S. military and naval academies, what sense is there in the talk of 'a violent departure from all precedent' involved in a provision for a crowning university of the United States?

10. What argument that justifies a State university would not justify a national university?

11. Contrary to the views of the Memorial Institution's advocates, no university is national, whatever its 'constituency,' 'support,' 'policies' and 'sympathies,' which is not vitally and distinctively of and by the Government of the United States.

12. People are most interested in that to which they contribute, and they cannot be so easily interested in a private institution as in an institution to which they have in some form contributed, which they may justly claim to be their own, and in which alone they could have a national pride.

13. The plan of the Memorial Institution necessitates practical duplication of Government experts and scientific apparatus, a thing which the Government could properly effect only in the interest of an institution of its own creation and in due measure subject to its control.

14. If there should be a measure of competition between a national university and a few other universities, that would by no

means be a serious matter. Among existing institutions competition even proves a means of rapid growth. Neither Harvard nor Columbia collapsed when the Johns Hopkins and Chicago Universities were established. Moreover, on the national side there would be the least possible of this element, for two important reasons, namely: First, because the purpose to do a work for the most part beyond existing institutions—that is, to occupy a field especially its own—would be both controlling and constant; and, secondly, because, by reason of its origin, aims and connection with the Government, there would not only be no room for a spirit of competition with the other institutions of the country, but rather, on account of direct relations with them, a sincere and never-failing desire to promote their advancement.

15. If the existing institutions already 'far more than supply the needed opportunities for higher study and research in the United States,' why do the richest of them strive for greater facilities; why do thousands go abroad annually for facilities which cannot be obtained in this country; and what is the need of the 'Memorial Institution'?

16. If the national opportunities sought to be utilized through the Memorial Institution are of a 'genuine university character,' why not have a genuine national university to utilize them?

It thus appears that while, on the one hand, the Memorial Institution contemplates no sort of advantage which in due measure the friends of a national university have not considered and set forth, on the other it has agreed on and published certain definite and independent plans for use of the Government Departments and bureaus such as no private institution but this would be likely to venture, and which the National University Committee has not felt warranted in planning for the University of the United States.

OVER-ESTIMATES OF EXTENT OF OPPOSITION.

Citizens here and there, with a supreme interest in certain institutions, cannot immediately subordinate all personal, local, and denominational ambitions, so as to take the national and world view of this matter. Or, if seeing rightly, as it is believed some of them do, they have not yet made up their minds to suffer the temporary losses and reproaches liable to follow a patriotic declaration of independence. If, therefore, I have at any time spoken of the half-dozen institutions whose present executive heads do not concur, as opposing the national university idea, the remark was too sweeping, for I am now satisfied that many of the broadest of the men thus embraced are in heart with us, that the opponents in these institutions constitute a minority only, and that of these many will be found on the affirmative side when fully informed concerning the national university proposed.

SPECIAL OFFICES OF A NATIONAL UNIVERSITY.

Neither the above mentioned nor the unenlisted of whatever class or quarter have yet realized that the efforts made for a national university are not so much because we are still without a single exclusively post-graduate university in America, and are therefore properly regarded by the foreign world as in the second rank, with thousands of our graduates annually going abroad for the facilities we do not furnish, but rather because the national university we seek to have established at Washington would fulfill special offices of national importance which none other, whether private, denominational, or state, much less this Memorial Institution, could by any possibility fulfill—among them these:

1. It would serve to supplement, coordinate, guide, inspire and finally perfect the whole series of public educational agencies in the United States and thus entitle us to speak of 'The American System

of Education '—a system such as this great republic certainly should have without further delay.

In the words of the editor of SCIENCE, issue of February 5, 1897, "A great national university would be the head of our educational system. It would not interfere with existing universities any more than these interfere with our colleges, or our colleges with our schools. Our present universities consist chiefly of professional schools, on the one hand, and of colleges for the instruction of boys on the other. They are indeed developing toward true universities, but nothing could better hasten and direct this development than a national university."

2. A national university could more properly than other institutions, with less embarrassment to the Government, and with great common advantage, still further utilize the resources already at Washington in the form of libraries, museums, gardens, laboratories and observatories, at a cost of $40,000,000 to the whole people, and all of which, together with the $7,000,000 a year for maintenance and utilization, and the possible help of scientific and practical experts, are, in some part, as I have said before, an enormous capital running to waste.

3. A national university would powerfully influence ambitious students in the public schools of whatever grade, even though purposing to make their college studies, or even a measure of post-graduate study, in denominational institutions of their preference. They would keep it in view as the final goal, the place of final preparation for special spheres of activity in life.

4. Moreover, a national university would at the same time in many ways help, and in nowise hinder, all the other institutions of the country; for in the first place, being without general academic courses of study, like a college, it would receive college and university graduates for special studies only, leaving the general work looking to purely academic degrees (certainly those below the doctorate) to existing colleges and universities; and, secondly, being free from both local and denominational ambitions, it would naturally deal with all institutions of high rank and doing any work supremely well, in a most liberal manner, and in harmony with the best system of cooperation that could be devised.

5. When in full operation the national university would be more effective than all other institutions in keeping at home the three to five thousand of our graduates who now annually go abroad for the completion of their studies. The honor of its approval would soon come to be esteemed before any that could be offered by the foreign world.

6. A national university would at length attract thousands of students of high character and attainments from other lands, whose return, after years of contact with a prosperous, cultured and happy people living under free institutions, would tend to promote the cause of liberal government everywhere.

7. A national university would be able, as would none other, to attract to its own service, as lecturers, expert workers, guides, and directors, many of the most gifted and best qualified of those in the Government service at Washington, with the triple advantage of economy to the university, of increase of revenue to those so employed, and of an improved service in the Government through the added attraction thus furnished to superior men and women who now hesitate and ofttimes refuse to enter the service because of insufficient salaries and the less than satisfying dignity of many positions on this very account. In other words, men of genius and rare acquirements would accept places in the Government, and of lower grade than otherwise,

because of promised or probable connection with the world's leading university.

8. As could none other, a national university would attract men of genius and distinction from every quarter of the world to its professorships, lectureships and fellowships, thus increasing the cultured intellectual forces of both university and country.

9. A national university, to an important extent, and as could no other institution, whatever its rank, would make itself a coworker with the Government in the several Departments; meeting their demands with the least possible delay; making trustworthy answers (as in the military and naval Academies) to important questions; taking up, on request, the solution of difficult problems of every sort; and supplying the Government with experts of supreme ability in greater number because drawn from the field of the world.

10. A national university would create an atmosphere at the national capital that would be influential for good in all departments of the Government, and so increase the demand for public men of character and culture as to furnish a new guaranty of wise legislation, and justice of judgment, as well as of faithfulness and efficiency of administration.

11. A national university, thus honored and encouraged, would powerfully stimulate and strengthen the patriotic sentiment of the country. The people universally would come to feel a pride in it as a sign of intellectual supremacy and of exalted aims, while to students in the schools and colleges of the States it would furnish a juster conception of what is meant by the field of learning, as well as new incentives to higher, and the highest possible, attainments; thus contributing in a degree beyond calculation to make us an educated people, and filling us with the determination to become the most cultured of all peoples.

12. Having duly established a university of the United States and made it capable of fulfilling all these offices, so important, shall we not have gained for our country that rank and influence among the nations to which not all our vast and varied material resources, the genius and wonderful energy of our people, and all our conquests in war are alone equal? Heirs to the better part of this great continent, with its vast resources of every sort, we have indeed made a wonderful growth in area, population, wealth and power; and meanwhile there has been a corresponding development in the boundless realm of the sciences, so that the national university we should now establish must differ in some respects (those of extent and greatness) from that which would have been founded in the days of Washington. Nevertheless, the special reasons which he so clearly had in mind have not only remained, as they ever must, but have strengthened with the years. They inhere in the nature of the case and should be regarded as conditions of a real supremacy of the American republic and of its becoming the world's most effective promoter of human advancement.

Other offices to be fulfilled by a national university will suggest themselves; but are not these enough to satisfy and forever silence the query, "Do we really need another and national university?"

The establishment by Congress of a national university is an undertaking of so great importance, of such origin, and of such advocacy throughout the whole period of the nation's life as to have gained an abiding place in the hearts of the people. It is an undertaking, the necessity for whose success is a firm conviction among the men most worthy to be heard in the interest of American education, and one the leadership in which, from first to last, has been as purely patriotic as any that was ever known, in peace or war. Such an

undertaking will surely triumph. Schemes skilfully devised may delay, but they cannot prevent, the establishment of a University of the United States.

JOHN W. HOYT,
Chairman National University Committee.

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*ADDRESS OF THE PRESIDENT OF THE PHYSIOLOGICAL SECTION OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.**

WHEN the British Association met in Glasgow twenty-five years ago I had the honor of presiding over Physiology, which was then only a subsection of Section D. The progress of the science during the quarter of a century has been such as to entitle it to the dignity of a section of its own, and I feel it to be a great honor to be again put in charge of the subject. While twenty-five years form a considerable portion of the life of a man, from some points of view they constitute only a short period in the life of a science. But just as the growth of an organism does not always proceed at the same rate, so is it with the growth of a science. There are times when the application of new methods or the promulgation of a new theory causes rapid development, and there are other times when progress seems to be slow. But even in these quiet periods there may be steady progress in the accumulation of facts, and in the critical survey of old questions from newer points of view. So far as physiology is concerned, the last quarter of a century has been singularly fruitful, not merely in the gathering in of accurate data by scientific methods of research, but in the way of getting a deeper insight into many of the problems of life. Thus our knowledge of the phenomena of muscular contraction, of the changes in the secreting cell, of the interdependence of organs illustrated by what we now speak of as internal secretion, of the events that occur in the fecundated ovum and in the actively growing cell, of the remarkable processes connected with the activity of an electrical organ, and of the physiological anatomy of the central nervous organs, is very different from what it was twenty-five years ago. Our knowledge is now more accurate, it goes deeper into the subject and it has more of the character of scientific truth. For a long period the generalizations of physiology were so vague, and apparently so much of the nature of more or less happy guesses, that our brethren, the physicists and chemists, scarcely admitted the subject into the circle of the sciences. Even now we are sometimes reproached with our inability to give a complete solution of a physiological problem, such as, for example, what happens in a muscle when it contracts; and not long ago physiologists were taunted by the remark that the average duration of a physiological theory was about three years. But this view of the matter can only be entertained by those who know very little about the science. They do not form a just conception of the difficulties that surround all physiological investigation, difficulties far transcending those relating to research in dead matter; nor do they recollect that many of the more common phenomena of dead matter are still inadequately explained. What, for example, is the real nature of elasticity; what occurs in dissolving a little sugar or common salt in water; what is electrical conductivity? In no domain of science, except in mathematics, is our knowledge absolute; and physiology shares with the other sciences the possession of problems that, if I may use a paradox, seem to be more insoluble the nearer we approach their solution.

The body of one of the higher animals—say that of man—is a highly complex mechanism, consisting of systems of organs, of individual organs and of tissues. Physi-

* Glasgow meeting, 1901.

ologists have been able to give an explanation of the more obvious phenomena. Thus locomotion, the circulation of the blood, respiration, digestion, the mechanism of the senses and the general phenomena of the nervous system have all been investigated, and in a general way they are understood. The same statement may be made as to the majority of individual organs. It is when we come to the phenomena in the living tissues that we find ourselves in difficulties. The changes happening in any living cell, let it be a connective tissue corpuscle or a secreting cell or a nerve-cell, are still imperfectly understood; and yet it is upon these changes that the phenomena of life depend. This has led the more thoughtful physiologists in recent years back again to the study of the cell and of the simple tissues that are formed from cells. Further, it is now recognized that if we are to give an adequate explanation of the phenomena of life, we should study these, not in the body of one of the lower organisms, as was at one time the fashion, where there is little if any differentiation of function—the whole body of an amœboid organism showing capacities for locomotion, respiration, digestion, etc.—but in the specialized tissue of one of the higher animals. Thus the muscle-cell is specialized for contraction, and varieties of epithelium have highly specialized functions.

But when cells are examined with the highest microscopic powers, and with the aid of the highly elaborated methods of modern histology, we do not seem to have advanced very far towards an explanation of the ultimate phenomena. There is the same feeling in the mind of the physiologist when he attacks the cell from the chemical side. By using large numbers of cellular elements, or by the more modern and fruitful methods of micro-chemistry, he resolves the cell-substance into proteids, carbohydrates, fats, saline matter and water, with possibly other substances derived from the chemical changes happening in the cell while it was alive; but he obtains little information as to how these proximate constituents, as they are called, are built up into the living substance of the cell. But if we consider the matter it will be evident that the phenomena of life depend on changes occurring in the interactions of particles of matter far too small even to be seen by the microscope. The physicist and the chemist have not been content with the investigation of large masses of dead matter, but to explain many phenomena they have had recourse to the conceptions of molecules and atoms and of the dynamical laws that regulate their movements. Thus the conception of a gas as consisting of molecules having a to-and-fro motion, first advanced by Krönig in 1856 and by Clausius in 1857, has enabled physicists to explain in a satisfactory manner the general phenomena of gases, such as pressure, viscosity, diffusion, etc. In physiology few attempts have been made in this direction, probably because it was felt that data had not been collected in sufficient numbers and with sufficient accuracy to warrant any hypothesis of the molecular structure of living matter, and physiologists have been content with the microscopic and chemical examination of cells, of protoplasm and of the simpler tissues formed from cells. An exception to this general remark is the well-known hypothesis of Du Bois-Reymond as to the existence in muscle of molecules having certain electrical properties, by which he endeavored to explain the more obvious electrical phenomena of muscle and nerve. The conception of gemmules by Darwin and of biophors by Weismann are examples also of a hypothetical method of discussing certain vital phenomena.

The conception, however, of the existence in living matter of molecules has not escaped some astute physicists. The sub-

ject is discussed with his usual suggestiveness by Clerk Maxwell in the article 'Atom' in the 'Encyclopædia Britannica' in the volume published in 1875, and he places before the physiologist a curious dilemma. After referring to estimates of the diameter of a molecule made by Loschmidt in 1865, by Stoney in 1868, and by Lord Kelvin (then Sir W. Thomson) in 1870, Clerk Maxwell writes:

"The diameter and the mass of a molecule, as estimated by these methods, are, of course, very small, but by no means infinitely so. About two millions of the molecules of hydrogen in a row would occupy a millimeter, and about two hundred million million million of them would weigh a milligram. These numbers must be considered as exceedingly rough guesses; they must be corrected by more extensive and accurate experiments as science advances; but the main result, which appears to be well established, is that the determination of the mass of a molecule is a legitimate object of scientific research, and that this mass is by no means immeasurably small.

"Loschmidt illustrates these molecular measurements by a comparison with the smallest magnitudes visible by means of a microscope. Nobert, he tells us, can draw 4,000 lines in the breadth of a millimeter. The intervals between these lines can be observed with a good microscope. A cube, whose side is the 4,000th of a millimeter, may be taken as the *minimum visible* for the observers of the present day. Such a cube would contain from 60 to 100 million molecules of oxygen or of nitrogen; but since the molecules of organized substances contain on an average about fifty of the more elementary atoms, we may assume that the smallest organized particle visible under the microscope contains about two million molecules of organic matter. At least half of every living organism consists of water, so that the smallest living being visible under the microscope does not contain more than about a million organic molecules. Some exceedingly simple organism may be supposed built up of not more than a million similar molecules. It is impossible, however, to conceive so small a number sufficient to form a being furnished with a whole system of specialized organs.

"Thus molecular science sets us face to face with physiological theories. It forbids the physiologist from imagining that structural details of infinitely small dimensions can furnish an explanation of the infinite variety which exists in the properties and functions of the most minute organisms.

"A microscopic germ is, we know, capable of development into a highly organized animal. Another germ, equally microscopic, becomes when developed an animal of a totally different kind. Do all the differences, infinite in number, which distinguish the one animal from the other arise each from some difference in the structure of the respective germs? Even if we admit this as possible, we shall be called upon by the advocates of pangenesis to admit still greater marvels. For the microscopic germ, according to this theory, is no mere individual but a representative body, containing members collected from every rank of the long-drawn ramification of the ancestral tree, the number of these members being amply sufficient not only to furnish the hereditary characteristics of every organ of the body and every habit of the animal from birth to death, but also to afford a stock of latent gemmules to be passed on in an inactive state from germ to germ, till at last the ancestral peculiarity which it represents is revived in some remote descendant.

"Some of the exponents of this theory of heredity have attempted to elude the difficulty of placing a whole world of wonders within a body so small and so devoid of

visible structure as a germ by using the phrase structureless germs. Now one material system can differ from another only in the configuration and motion which it has at a given instant. To explain differences of function and development of a germ without assuming differences of structure is, therefore, to admit that the properties of a germ are not those of a purely material system."

The dilemma thus put by Clerk Maxwell is (first) that the germ cannot be structureless, otherwise it could not develop into a future being, with its thousands of characteristics; or (second) if it is structural it is too small to contain a sufficient number of molecules to account for all the characteristics that are transmitted. A third alternative might be suggested, namely, that the germ is not a purely material system, an alternative that is tantamount to abandoning all attempts to solve the problem by the methods of science.

It is interesting to inquire how far the argument of Clerk Maxwell holds good in the light of the knowledge we now possess. First, as regards the *minimum visible*. The smallest particle of matter that can now be seen with the powerful objective and compensating eyepieces of the present day is between the $\frac{1}{400000}$ and the $\frac{1}{500000}$ of an inch, or $\frac{1}{200000}$ of a millimeter in diameter, that is to say, five times smaller than the estimate of Helmholtz of $\frac{1}{4000}$ of a millimeter. The diffraction of light in the microscope forbids the possibility of seeing still smaller objects, and when we are informed by the physicists that the thickness of an atom or molecule of the substances investigated is not much less than a millionth of a millimeter, we see how far short the limits of visibility fall of the ultimate structure of matter.

Suppose, then, we can see with the highest powers of the microscope a minute particle having a diameter of $\frac{1}{20000}$ of a millimeter, it is possible to conceive that some of the phenomena of vitality may be exhibited by a body even of such small dimensions. The spores of some of the minute objects now studied by the bacteriologist are probably of this minute size, and it is possible that some may be so minute that they can never be seen. It has been observed that certain fluids derived from the culture of microorganisms may be filtered through thick asbestos filters, so that no particles are seen with the highest powers, and yet those fluids have properties that cannot be explained by supposing that they contain toxic substances in solution, but rather by the assumption that they contain a greater or less number of organic particles so small as to be microscopically invisible. I am of opinion, therefore, that it is quite justifiable to assume that vitality may be associated with such small particles, and that we have by no means reached what may be called the vital unit when we examine either the most minute cell or even the smallest particle of protoplasm that can be seen. This supposition may ultimately be of service in the framing of a theory of vital action.

Weismann in his ingenious speculations has imagined such a vital unit to which he gives the name of a biophor, and he has even attempted numerical estimates. Before giving his figures let us look at the matter in another way. Take the average diameter of a molecule as the millionth of a millimeter, and the smallest particle visible as the $\frac{1}{20000}$ of a millimeter. Imagine this small particle to be in the form of a cube. Then there would be in the side of the cube, in a row, fifty such molecules, or in the cube $50 \times 50 \times 50 = 125{,}000$ molecules. But a molecule of organized matter contains about fifty elementary atoms. So that the 125,000 molecules in groups of about fifty would number $\frac{125000}{50} = 2{,}500$ organic particles. Suppose, as was done

by Clerk Maxwell, one-half to be water; there would remain 1,250 organic particles. The smallest particle that can be seen by the microscope may thus contain as many as 1,250 molecules of such a substance as a proteid.

Weismann's estimates as to the dimensions of the vital unit to which he gives the name of biophor may be shortly stated. He takes the diameter of a molecule at $\frac{1}{2000000}$ of a millimeter (instead of the one millionth) and he assumes that the biophor contains 1,000 molecules. Suppose the biopher to be cubical, it would contain ten in a row, or $10 \times 10 \times 10 = 1{,}000$. Then the diameter of the biophor would be the sum of ten molecules, or $\frac{1}{2000000} \times 10 = \frac{10}{2000000}$ or $\frac{1}{200000}$ of a millimeter. Two hundred biophors would therefore measure $\frac{200}{200000}$ or $\frac{1}{1000}$ mm. or $1\,\mu$ (micron $= \frac{1}{1000}$ mm.). Thus a cube one side of which was $1\,\mu$ would contain $200 \times 200 \times 200 = 8{,}000{,}000$ biophors. A human red blood corpuscle measures about $7.7\,\mu$; suppose it to be cubed, it would contain as many as 3,652,264,000 biophors.

Now if the smallest particle that can be seen ($\frac{1}{20000}$ mm.) may contain 1,250 molecules, let us consider how many exist in a biophor, which we may imagine as a little cube, each side of which is $\frac{1}{200000}$ mm. There would then be five in a row of such molecules, or in the cube $5 \times 5 \times 5 = 125$ molecules; and if the half consisted of water about sixty molecules.

Let us apply these figures to the minute particles of matter connected with the hereditary transmission of qualities. The diameter of the germinal vesicle of the ovum is $\frac{1}{20}$ of a millimeter. Imagine this a little cube. Taking the diameter of an atom at $\frac{1}{10000000}$ of a millimeter, and assuming that about fifty exist in each organic molecule (proteid, etc.), the cube would contain at least 25,000,000,000,000 organic molecules. Again, the head of the spermatozoid, which is all that is needed for the fecundation of an ovum, has a diameter of about $\frac{1}{200}$ mm. Imagine it to be cubed; it would then contain 25,000,000,000,000 organic molecules. When the two are fused together, as in fecundation, the ovum starts on its life with over 25,000,000,000,000 organic molecules. If we assume that one-half consists of water, then we may say that the fecundated ovum may contain as many as about 12,000,000,000,000 organic molecules. Clerk Maxwell's argument that there were too few organic molecules in an ovum to account for the transmission of hereditary peculiarities does not apparently hold good. Instead of the number of organic molecules in the germinal vesicle of an ovum numbering something like a million, the fecundated ovum probably contains millions of millions. Thus the imagination can conceive of complicated arrangements of these molecules suitable for the development of all the parts of a highly complicated organism, and a sufficient number, in my opinion, to satisfy all demands of a theory of heredity. Such a thing as a structureless germ cannot exist. Each germ must contain peculiarities of structure sufficient to account for the evolution of the new being, and the germ must therefore be considered as a material system.

Further, the conception of the physicist is that molecules are more or less in a state of movement, and the most advanced thinkers are striving towards a kinetic theory of molecules and of atoms of solid matter which will be as fruitful as the kinetic theory of gases. The ultimate elements of bodies are not freely movable each by itself; the elements are bound together by mutual forces, so that atoms are combined to form molecules. Thus there may be two kinds of motion, atomic and molecular.

By molecular motion is meant, "the translatory motion of the centroid of the atoms that form the molecule, while as atomic motion we count all the motions which the atoms can individually execute without breaking up the molecule. Atomic motion includes, therefore, not only the oscillations that take place within the molecule, but also the rotation of the atoms about the centroid of the molecule." *

Thus it is conceivable that vital activities may also be determined by the *kind* of motion that takes place in the molecules of what we speak of as living matter. It may be different in kind from some of the motions known to physicists, and it is conceivable that life may be the transmission to dead matter, the molecules of which have already a special kind of motion, of a form of motion *sui generis*.

I offer these remarks with much diffidence, and I am well aware that much that I have said may be regarded as purely speculative. They may, however, stimulate thought, and if they do so they will have served a good purpose, although they may afterwards be assigned to the dust-heap of effete speculations. Meyer writes as follows in the introduction to his great work on 'The Kinetic Theory of Gases,' p. 4: "It would, however, be a considerable restriction of investigation to follow out only those laws of nature which have a general application and are free from hypothesis; for mathematical physics has won most of its successes in the opposite way, namely, by starting from an unproved and unprovable, but probable, hypothesis, analytically following out its consequences in every direction, and determining its value by comparison of these conclusions with the result of experiment."

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University of Glasgow.

* Meyer, 'Kinetic Theory of Gases.' Translated by Baynes, London, 1899, p. 6.

DATA ON SONG IN BIRDS. OBSERVATIONS ON THE SONG OF BALTIMORE ORIOLES IN CAPTIVITY.

Much has been written in regard to the songs of birds, and no small part of the literature of the subject has dealt with the problem of the way in which many kinds of birds have acquired the distinctive song that characterizes each different species.

In the eastern United States many of us recognize, without seeing, the singer, on hearing the song of one of our commoner native birds. We say, 'A robin is singing,' 'Listen to the bobolink,' 'That is a song sparrow.'

Some who pay close and particular attention realize that individuals of a given kind have sometimes slight, though marked, variations in the method of song that distinguish them from the mass of their kind and characterize them as individuals which are readily known by their *peculiar personal song*. So we say, 'This robin is a good singer,' 'The note of that thrush is particularly pleasing,' 'That oriole has some harsh notes.' Such comments are indicative of the taste or appreciation of the listener and are only introduced here to emphasize two facts. First, that the song of all the individuals of a given kind of bird, as the robins, is so characteristic that we call it the robin's song, readily recognize it, and know that, in the main, all the robins of a given region have a common song, so much alike that we do not individualize the singer. Second, that now and again individual birds of a given kind, robins again for example, are readily distinguishable as individuals by some turn or phrasing of the notes that gives to the individual singer an identity as a particular robin, with an individual song, different, to a greater or less degree, from the mass of robins in the same region.

The question at once suggests itself: How is this characteristic song acquired?

Is it a matter of inheritance? Or does each robin learn to sing? Is it inherent in the species or is this song of the robin a matter of education?

A. R. Wallace and Lloyd Morgan especially have advanced hypotheses to account for the matter of call notes and song, and Mr. Morgan's work is based on many careful experiments that are set forth in his book, 'Habit and Instinct.' But, so far, I am not aware of any prolonged or detailed account of the study of this factor, as it develops with, and extends through, the life of a given individual, nor has a second generation been carefully watched.

The following experiment, though imperfect and by no means as exhaustive as could be desired, seems, however, worthy of record, as from it certain conclusions may be drawn. The notes accumulated extend over a period of nearly five years and are briefly as follows:

On July 7, 1895, I took from a maple tree at Annisquam, Massachusetts, a nest of the Baltimore oriole (*Icterus galbula*), which contained three very young birds. They were quite naked and showed no signs of wing or tail feathers. They appeared to be about five days old. As a record to refer to, one was killed and preserved in alcohol. The other two were carefully reared by hand and throve well.

So far as I know, they did not hear, after coming into my possession, any birds sing, nor did any person whistle or sing to them.

At the age of between three and four weeks they were able to feed and care for themselves. They began then to fly from place to place about the room, and it became necessary to confine them in a cage. However, they were allowed the larger liberty of the sitting room for a portion of each day and were very tame and familiar, for a long period calling for food in the characteristic oriole way and begging with drooping fluttering wings of any one who came into the room.

By August 1 they were fully fledged and the downy first plumage of the head and body began to be replaced by the compact and finished plumage of the first autumn. The wing and tail feathers were, however, not moulted at this time.

During the first week in October, the birds were taken by me to Boston. Here I lived in rooms on the upper floor of a four-story house where there were no other birds in confinement, so that no song of any kind was heard by the birds while at this place.

Now I began to appreciate that both were female birds and also noted great temperamental differences in the two. One was timid, and the other taking advantage of this characteristic, scolded and chased the timid bird both in the cage and when at large in the room. So by name I began to distinguish them as Driver and Timid, which last soon became Timmy, a name always associated in my mind with Baltimore orioles.

At this time they had a single call note very like that of wild birds, but with a slightly different quality difficult to define, more abrupt, musical and much louder. They also had the peculiar rattling chatter associated with orioles. These were all their notes and were uttered rarely, the infant appeal so prevalent during the first four weeks of their lives having disappeared with their babyhood.

During the next few months their lives had no marked events. Each day they spent much time out of the cage at large in the room. Threads interested them, and hours were spent by the two birds in sewing, for I can use no other word, threads and strings into the wire bars of the cage they lived in. Without any semblance of weaving a nest or attempting to shape one, the birds simply tied and wove the threads

into the wire until there were no loose ends. Ultimately thick bunches of thread and string on the bars characterized the cage.

I have told all this detail, really foreign to my thesis, because it seems important to record an inheritance so marked. The birds never learned to do more with threads than is here described, though they were ultimately allowed a room to live in with branches of trees to alight on, etc., and at least one of them laid eggs in an artificial nest.

On February 16, 1896, I took the birds by train from Boston to New York, where they spent the succeeding months until May 6 in a room in a large hotel. I wish to emphasize again two facts: both birds were females though I was not absolutely sure of it at this period, and, so far as I am aware, they heard no birds sing after I took them from their parents when about five days old, until after I took them to the country again on May 6, as will presently be related.

After reaching New York it was found expedient to keep them in separate cages when confined, though they were daily allowed much liberty at large in the room. During the last of February a partial moult occurred in both birds. This was chiefly the feathers of the head, throat and back. The wing and tail feathers were not shed.

Till now the two birds had looked so much alike, that in order to readily distinguish them I had early in October clipped the tips of the secondary feathers in one of Timmy's wings. This was a distinct mark even with the wings closed. But with the moult I am about to discuss, the birds ceased to be alike in appearance and were readily recognized.

Timmy in this moult acquired a distinct black throat patch, some black arrow-shaped marks in the feathers of the top of the head and decidedly dusky patches about the region of the ears. The throat patch extended over the throat proper. The entire period taken in completing this moult was about three weeks.

The other bird, Driver, did not acquire any decided black marking about the head, throat or ears, and only showed a few scattered tiny black feathers.

Before this moult was quite completed, during the latter part of February, the birds began to sing. The interval between the singing was sometimes several days, and only a very few minutes in each day were devoted to song. This song was very low and soft, and more or less broken, reminding one of the song of the white-throated sparrow (*Z. albicollis*) as it is heard during the fall and in the early spring migrations.

Timmy was the first to sing in this way, and the period of song when noticed was brief, not lasting more than about one minute. The song was not heard again for several days. Then it became of daily occurrence, and was gradually more prolonged and better sustained. About five days after Timmy began to sing, Driver sang also. Driver soon became the chief singer, so that Timmy's weaker song was not so noticeable. But both increased in volume, and frequency all through the month of March, and during April and the first half of May while daylight lasted, the song was incessant in both birds. It was now a loud clear series of notes of great brilliancy, and poured forth in such rapid succession as to be like that of the house wren (*T. aëdon*) in the intervals, and lasting about as long as the warble of that bird. Except for the 'rattle' which was now and then a part of the repertoire, this song had nothing in it that reminded one of the song of the Baltimore oriole as heard in New York, Massachusetts or at any point where the birds occur. Through the second week in May, the song of both birds gradually diminished.

I could generally, during the height of the song season, start the birds to sing by going to their cages, speaking to them and whistling a few notes. Here it seems essential to emphasize the fact that I in no way trained them to sing and made no effort to start them in song till long after their method of singing was established. In fact, the quality and phrasing of their singing was of such a character that none save an expert whistler could reproduce it.

Early in May of 1896 I took the birds to the country near New York, where we remained until July 20, 1897, a period of some fourteen months; then I moved to Princeton, New Jersey, where the remainder of their lives was passed. Both birds died during the winter of 1899–1900, apparently of old age.

To go back to the time of departure from New York in the spring of 1896. As has been stated, the birds' song became less frequent by the first week in May, and by the twentieth of that month they had ceased to sing. On June 6 I noticed the first signs of the summer moult and in a very few days it was in full progress.

It may be well to indicate some of the details of the change, though this is a divergence from the chief subject. Also, it should be borne in mind that native birds kept in confinement are generally about a month earlier in moulting and also in the song season, than are the representatives of the same species at liberty out of doors. This applies to all the species I have kept in confinement and when the birds are perfectly normal and healthy—so sound in health as to *breed in captivity*, which seems a good criterion. As examples, I may mention the bluebird (*S. sialis*), robin (*M. migratoria*), wood thrush (*H. mustelina*), catbird (*G. carolinensis*), brown thrasher (*H. rufus*), and the orchard oriole (*I. spurius*), all of which I have had live and breed and go through the song and moult seasons year after year in captivity.

The moulting period of the two orioles occupied a month, and early in July both were in most exquisite fall plumage. The deeper orange and rusty tint that is so characteristic of the species, and the suffusion of the black areas on the throat, were as marked and fine in detail as in wild birds. At this moult for the first time the larger wing and all the tail feathers were shed and replaced. The two birds were marvels of beauty at all times, but just after the full summer moult they filled those who saw them with admiration and wonder. After the moult there was a secondary song season of short duration. The song was of the same character, but not so prolonged or elaborate.

So I have endeavored to give an idea of a year, or rather more, of these birds' lives, and the succeeding years to the end were but repetitions with but slight variation.

Each year the wearing of the tips of the feathers was apparent in January, and a partial moult such as I have described took place late in that month or in February. Then began again the peculiar low soft song at infrequent intervals, presently becoming noticeable in volume and occurrence, till the song wave reached its height and died away. Each early June found the birds putting on an entirely new garment of feathers.

I have spoken before in this paper of the observations of a second generation. I find that this perhaps conveys a wrong impression. Let me say at once that the second generation consisted of a brood of young orioles in no way related to Timmy or Driver. However, for the purpose of my subject, really these were a second generation, of birds of a given kind, subject to the influence of older birds of their own species.

On June 15, 1897, when Timmy and

Driver had passed through the song seasons and had a well-established song formula of their own, I obtained a brood of Baltimore orioles which I believed to be about six days old. The birds were secured at South Orange, N. J., a point several hundreds of miles from the birthplace of my original birds, Timmy and Driver. I shall distinguish these birds, when speaking of them, as the brood of 1897. They were reared in the same way that the other orioles had been, except that they had the *society of, and were closely associated during their early lives with*, the two older orioles.

The moults occurred at the same intervals that I have indicated, and by the winter of 1897–1898 I was able to distinguish the sexes of my four new birds by the characteristics that correlate with sex. Three were males and assumed full nuptial plumage by a partial moult in late January and part of February. The fourth bird was a female.

On my coming to live in Princeton when these 1897 orioles were about seven weeks old, they, as well as Timmy and Driver, had an especial room given over to their use, and from that time on the birds knew little or nothing of cage life.

After the spring or, rather, late winter moult of 1898, Timmy and Driver began to sing as they had done in the two previous years. At this time friends, good field ornithologists, familiar with the conventional song of the Baltimore oriole, heard them both sing, and not having up to that time seen the birds, were at a loss to identify the song as being like anything they had ever heard.

Soon after Timmy and Driver began to sing, the 1897 birds one by one joined, and in a month all were singing a song not to be distinguished from that of the two older birds. They outlived Timmy and Driver a year or more and always sang as I believe they had been taught by older birds of their own kind. In short, only six orioles have ever sung this song, for I pursued the experiment no farther, other matters interfering.

My conclusion is that two birds, *isolated from their own kind and from all birds*, but with a strong inherited tendency to sing, originated a novel method of song, and that four birds, *isolated from wild representatives of their own kind, and associated with these two who had invented the new song*, learned it from them and never sang in any other way.

William E. D. Scott,
Curator of Ornithology.
Princeton University.

THE BOTANICAL SOCIETY OF AMERICA.

The Botanical Society of America met in business sessions in Room 4 of the High School Building, Denver, Col., August 27 and 28, 1901, and presented its scientific program in joint session with Section G of the A. A. A. S. in the same place on August 28. The Presidential address on 'The Problems and Possibilities of Systematic Botany,' by Professor B. L. Robinson, was read by Dr. J. M. Coulter. The following program was presented:

'The Fundamental Phenomena of Vegetation': F. E. Clements.

'The Physical Basis of Ecology'; F. E. Clements.

'A System of Nomenclature for Phytogeography': F. E. Clements.

'The Plant Formations of the Rocky Mountains': F. E. Clements.

'Early Winter Color of the Plant Formations of the Great Plains': C. E. Bessey.

'The Anatomy of the Embryo and Seedling of *Tsuga Canadensis* Carr' (by invitation): W. A. Murrill.

'Clues to Relationships among Heterœcious Plants': J. C. Arthur.

'The Thermal Relations of Vegetation': D. T. MacDougal.

'The Application of Ecology in Taxonomy': F. E. Clements.

'Some of the Changes now taking place in a Forest of Oak Openings': W. J. Beal.

'The Life-History of *Vittaria Lineata*': E. G. Britton and A. Taylor.

In accordance with the adoption of an amendment to the Constitution of the A. A. A. S., Drs. Bessey and Halsted were chosen to represent the Society on the Council of the Association at the sessions just finished.

A committee consisting of Drs. Wm. Trelease, N. L. Britton and B. L. Robinson was appointed to report upon the condition of the National Herbarium, and to recommend changes for its improvement.

As a result of consideration of the report of the committee on the policy of the Society appointed a year ago, it was resolved "That it is the present policy of the Society to accumulate invested funds until the annual income, interest and dues, is at least $500, and then to use such income yearly, or at greater or less intervals, as circumstance may dictate, for the best advancement of botanical knowledge."

The address of the retiring President at the next annual meeting will be delivered by Professor B. D. Halsted, who presided over the session, and whose term of office has just expired.

The officers for the ensuing year are:

President, J. C. Arthur.
Vice-President, B. T. Galloway.
Treasurer, C. A. Hollick.
Secretary, D. T. MacDougal.
Councillors, C. E. Bessey and Wm. Trelease.

D. T. MACDOUGAL,
Secretary.

NEW YORK BOTANICAL GARDEN,
BRONX PARK, N. Y. CITY.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FELLOWS ELECTED AT THE DENVER MEETING.

John Almy, Instructor in Physics, University of Nebraska, Lincoln, Nebr. (B).

J. H. Appleton, Professor of Chemistry, Brown University, Providence, R. I. (C).

Howard Ayers, President, University of Cincinnati, Cincinnati, Ohio (F).

Solon I. Bailey, Associate Professor of Astronomy, Harvard University, Cambridge, Mass. (A).

Simeon E. Baldwin, Associate Judge of Supreme Court of Errors, New Haven, Conn. (I).

W. D. Bancroft, Professor of Physical Chemistry, Cornell University, Ithaca, N. Y. (C).

C. R. Bardeen, Anatomical Laboratory, Wolfe and Monument Sts., Baltimore, Md. (F, K).

A. E. Beardsley, Professor of Biology, State Normal School, Greeley, Colo. (F).

John Andrew Bergström, Associate Professor of Psychology and Pedagogy, Indiana University, Bloomington, Ind. (K).

Ernst A. Bessey, Department of Agriculture, Washington, D. C. (G).

Frank W. Blackmar, Professor of Sociology and Economics, University of Kansas, Lawrence, Kansas, (I).

E. M. Blake, University of California, Berkeley, Cal. (A).

Thaddeus L. Bolton, Department Philosophy, University of Nebraska, Lincoln, Nebr. (K).

Louis F. G. Bouscaren, Chief Engineer, Water Works Commission, Cincinnati, Ohio (D).

Charles L. Bouton, Instructor in Mathematics, Harvard University, Cambridge, Mass. (A).

Wm. L. Bray, Professor of Botany, University of Texas, Austin, Texas (G).

Lyman J. Briggs, U. S. Dept. of Agriculture, Washington, D. C. (B).

S. J. Brown, U. S. N., U. S. Naval Academy, Annapolis, Md. (A).

Lawrence Bruner, Professor of Entomology, University of Nebraska, Lincoln, Nebr. (F).

Edward F. Buchner, New York, N. Y. (H, K).

Luther Burbank, Horticulturist, Santa Rosa, Cal. (G).

E. S. Burgess, Botanist, 11 W. 88th St., New York, N. Y. (G).

E. A. Burt, Professor of Natural History, Middlebury College, Middlebury, Vt. (G).

William Cain, Professor of Mathematics, University of North Carolina, Chapel Hill, N. C. (A, D).

Florian Cajori, Professor of Mathematics, Colorado College, Colorado Springs, Colo. (A).

C. N. Calkins, Instructor in Zoology, Columbia University, New York, N. Y. (F).

F. K. Cameron, Bureau of Soils, U. S. Department of Agriculture, Washington, D. C. (C).

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H. W. Cattell, Pathologist, 3709 Spruce St., Philadelphia, Pa. (K).

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T. M. Cheesman, Pathologist, Garrison-on-Hudson, N. Y. (K).

C. M. Child, Instructor in Zoology, University of Chicago, Chicago, Ill. (F).

Frank Hurlbut Chittenden, Assistant Entomologist, U. S. Dept. Agriculture, Washington, D. C. (F).

Russell H. Chittenden, Dean Sheffield Scientific School, Yale University, New Haven, Conn. (C, K).

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Edwin Grant Conklin, Professor of Biology, University of Pennsylvania, Philadelphia, Pa. (F).

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F. B. Crocker, Professor of Electrical Engineering, Columbia University, New York, N. Y. (B, D).

John Franklin Crowell, Bureau of Statistics, U. S. Treasury Dept., Washington, D. C. (I).

Edgar R. Cumings, Indiana University, Bloomington, Ind. (E).

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Allerton Cushman, Instructor in Chemistry, Bryn Mawr College, Bryn Mawr, Pa. (C).

Arthur R. Cushny, Professor of Materia Medica and Therapeutics, University of Michigan, Ann Arbor, Mich. (K).

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Eben S. Wheeler, U. S. Assistant Engineer, Detroit, Mich. (D).

Henry Lord Wheeler, Assistant Professor of Chemistry, Sheffield Scientific School, Yale University, New Haven, Conn. (C).

William Morton Wheeler, Professor of Zoology, University of Texas, Austin, Texas (F).

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SCIENTIFIC BOOKS.

Diplodocus Marsh. *Its Osteology, Taxonomy and Probable Habits, with a Restoration of the Skeleton. Memoirs of the Carnegie Museum*, Vol. I., pp. 1–63, pl. I.–XIII.

The *Memoirs of the Carnegie Museum* open auspiciously with this valuable contribution by Mr. J. B. Hatcher, curator of the department of vertebrate paleontology and associate editor of the publications of the Museum. The subject is the description of two remarkable skeletons of the great sauropodous dinosaur *Diplodocus* discovered by the Museum expeditions of 1899 and 1900 on Sheep Creek, Albany County, Wyoming. The first specimen consists of forty-one vertebræ, which form an unbroken series from the second or axis vertebra to the twelfth vertebra of the tail, besides extensive parts of the appendicular skeleton, all in a remarkable state of preservation. The fourteen cervicals alone measure 21 feet and the author estimates a total length of 68 feet for the vertebral column and skull. The second skeleton belongs to a smaller animal in which one of the hind limbs is perfectly preserved, and with the aid of a fore limb and of some characters taken from the tail of a specimen in the American Museum collection, Mr. Hatcher gives (Plate XIII.) by far the most perfect restoration of a Sauropod which has yet been published. The neck is extraordinarily long and slender, increasing in power and in the length of the centra near the chest. The back, including only eleven vertebræ with short centra is extremely short; while the long and heavy tail evidently balances the anterior portion of the column, and the sacrum forms the center of the body. The marvelously light and yet strong structure of the vertebræ is well brought out in the pen drawings by Mr. Weber, and the author adds a number of most useful new terms for the future description of these elaborate structures. Of the animal as a whole he observes:

> The restoration at once reveals the unusual proportions of *Diplodocus*. The remarkable long neck and tail contrast strikingly with the short body. The hind limbs are longer than the fore limbs, and this fact, together with the enormous elevation of the spines of the sacrals and posterior dorsals, fixes the sacral region as the highest in the vertebral column, a determination first made by Osborn. The powerful ilia, firmly united to the rigidly coossified sacrals with lofty coalesced spines, together with the other pelvic elements proportionately well developed, at once emphasizes the paramount importance of the pelvic region and fixes it as the center of power and motion.

Among the new important points brought out in this Memoir are the following: First, the gradual transition from the paired spines of the neck to the highest single spines of the back; the clear description and definition of the remarkable cavities surrounding the vertebræ, intramural or inside of the bones as well as around the centra and neural arches; the modification of the first two dorsals especially for the support of the scapula; the presence of four true sacrals and of one dorso-sacral or pelvic vertebra, strengthening the support of

the ilium; the fact that the posterior sacral is larger than the anterior, showing the enormous power exerted by the tail; the coossification of the 17th and 18th caudal vertebræ, indicating that this was a fixed point when the animal stood upon its hind feet and partly supported itself upon the tail in the tripodal condition; the excessively small neural canal throughout, the probable presence of a pair of clavicles, not hitherto observed in the Sauropoda; the hollow character of the large limb bones.

These skeletons are referred to a new species, *D. carnegiei*, in honor of the founder of the Pittsburgh Museum.

As regards the habits of these animals Mr. Hatcher speaks as follows:

> From the above consideration I am inclined toward the opinion that *Diplodocus* was essentially an aquatic animal, but quite capable of locomotion on land. Though living for the most part in the more important rivers and fresh-water lakes, it may not infrequently have left the water and taken temporarily to the land, either in quest of food or in migration from one to another of adjacent bodies of water.
>
> It is not improbable that during the period when these huge dinosaurs lived and flourished over what is now New Mexico, Colorado, Wyoming, Montana and the Dakotas, there prevailed throughout this region physical conditions somewhat similar to those which exist to-day in tropical America and more especially over the costal plain of the lower Amazon with its numerous bayous and islands, or the more elevated valleys of the anterior in the Brazilian provinces of Amazonas and Matto Grosso with their numerous lakes and large rivers surrounded by a dense tropical vegetation with broad, level valleys subject to periodical inundations.
>
> With the beginning of the Cretaceous there began a subsidence over this region, and a great inland sea was formed which gradually encroached upon the habitat of these animals, more and more restricting the area adapted to them, so that at about the commencement of the Upper Cretaceous the entire region formerly occupied by them had become a shallow sea save only certain islands of limited extent, and perhaps otherwise poorly adapted as the homes of such animals as were the *Sauropoda*.

A few years more of such efficient exploration as this and of such remarkably careful field and preparation work promises to give us a knowledge of the osteology of these great Sauropods almost as complete as our knowledge of the skeleton of the recent horse, for example. The author of the present work and Dr. J. L. Wortman, who found the type skeleton, have led the way in these methods of field work.

Henry F. Osborn.

An Introduction to Physiology. By William Townsend Porter, M.D., Associate Professor of Physiology in the Harvard Medical School. Cambridge, Mass., The University Press. Pp. 314.

This small volume contains in a convenient form what is apparently the course of practical physiology given for the past two or three years at the Harvard Medical School. To those who are not conversant with the difficulties that beset the practical teaching of the subject to large classes it may appear surprising that in this matter the large American medical schools should have lagged behind the smaller, in some of which courses of a considerably wider scope than that under review have not only, for the best part of a decade, been available for the advanced student of medicine, but have taken their place among the compulsory subjects of the ordinary curriculum. He, however, who knows how much wise planning and laborious organization —what material, intellectual and even moral resources—are required for the successful conduct of a practical class for a couple of hundred students will be much more ready to congratulate Dr. Porter and the Harvard Medical School on the satisfactory results of their efforts than to criticise them as belated laborers in the vineyard of practical physiology. Nor will the experienced teacher whose circumstances enable him to make free use of mammals as well as frogs seriously blame, however much he may regret, the entire omission of mammalian experiments, except those performed on the students themselves. He will nevertheless note that the lack of this element, so valuable, under proper conditions, in the training of the medical students, renders the book less suited to the requirements of schools of moderate size than would otherwise be the case. On the other hand, for those who are so situated that they can only use frogs, the work may be recommended as a sound guide to the performance of the fundamental experiments in the general physiology

of muscle and nerve. The mechanical phenomena of the circulation are also adequately treated in a series of exercises on an ingeniously constructed artificial scheme.

It would have been better, we think, to omit much of the elementary physics which bulks so largely in some of the chapters. The simple experiments on magnetic induction, lines of force and electromagnetic induction, given in Chapter II., would be in their proper place in a manual of practical physics. We doubt the wisdom of encouraging the medical student to neglect his physics, as he so often does at the period of his preliminary scientific studies, in the sure and certain hope that 'all he really requires,' the titbits of that severe and repellant science—will be served up to him later on in semi-digested form in the course of physiology.

The proofs have been read with commendable care, and few actual errors have escaped detection. On page 188, however, it is wrongly stated that 'in muscle the electrotonic currents are much stronger than in nerve.' The assertion, on page 189, that 'the electrotonic currents are absent in nerves which lack a myelin sheath' seems a little too absolute, although everybody admits that they are weaker than in medullated nerves. On page 250 one is rather staggered by the argument that 'were the slow passage of the blood in the capillaries due simply to friction, the blood would move still more slowly in the veins because the retarding influence of the friction in the viens would be added to that of the capillaries.' This would hold true if the blood possessed only kinetic energy. But since the blood in the capillaries is under a higher pressure than in the veins, there is a surplus of potential energy which is capable of being converted into kinetic.

It is a good idea to encourage the learner to discuss his results by setting him here and there a definite question for consideration. A critical comparison of the isotonic and isometric causes of contraction (pp. 221, 229) affords a valuable mental gymnastic to the student who has just been exercising his manual dexterity in obtaining them. And if Swift could extract an elegant meditation (according to the style and manner of the Hon. Robert Boyle) from so dry a piece of timber as a broomstick, the ingenuous reader will waste no sympathy on the twentieth-century medical student, even when he is requested to tackle a somewhat unpromising theme, to write, for example (according to his own style and manner) 'a critical account of the muscle-lever in his laboratory note-book.'

G. N. I. S.

Theory of Functions of a Complex Variable. By A. R. FORSYTH, Sc.D., F.R.S., Fellow of Trinity College, Cambridge, Sadlerian Professor of Pure Mathematics. Second Edition. Cambridge, at the University Press. 1900. 8vo. Pp. xxiv + 782.

The publication of a second edition of Professor Forsyth's very valuable and comprehensive work on the theory of functions is a matter of no little interest and importance to the mathematical world. The first edition, which appeared in the spring of 1893, was the first extended systematic presentation in English of a field of modern mathematics now generally recognized as the most useful as well as the most fascinating. Furthermore it was the most comprehensive treatise on the subject in any language, treating a greater number of departments, exhibiting a greater variety of methods, and giving more references to important original contributions than any previous work. Its position in all these respects has been modified since only by a single work, the elaborate historical and bibliographical report of Professors Brill and Noether published in the third volume of the 'Jahresbericht der deutschen Mathematiker-Vereinigung.'

The new edition has been enlarged by about one hundred pages. By means of these additional pages and also by omitting about twenty pages devoted in the earlier edition to binomial differential equations, the author has been enabled to introduce an elementary discussion of the birational transformations and to give some account of Abel's theorem and its applications.

In the work of revision many improvements in the details of presentation have been introduced. The author has altered the wording of a considerable number of theorems and demonstrations which before contained slips of one sort or another. The work has thereby gained

on the side of scientific precision without becoming less agreeable to read or less easy to understand.

It would, of course, be absurd to expect a work of the magnitude and scope of the present one to be free from errors of both omission and commission.* The present writer may be permitted to point out one of the former sort which seems particularly serious, viz: the omission of the fundamental proof of Cauchy relative to the continuity of the roots of an algebraic equation. On page 181 of the new edition, as on page 162 of the old edition, the author simply takes it for granted that when the independent variable changes continuously, so will every root of the algebraic equation.

Thomas S. Fiske.

Columbia University.

Discussion and Correspondence.

Preglacial Drainage in Southwestern Ohio.

To the Editor of Science: In Science for August 9, reference is made, in a review of Professor W. M. Davis, to recent papers by Tight, Bownocker, Todd and Fowke upon the subject of 'Preglacial Drainage of Ohio.' In particular Mr. Fowke is represented as advocating for the Licking and Kentucky rivers a continuance of their courses northward by way of a reversed Miami river or some of its tributaries. There seems to me to be an objection to this theory, which will become apparent to any one who will study the relation of the channels of the Miami river and its principal tributaries to the boundary outcrop of the lower and upper Silurian formations in that region. In a district where the dip of the rocks is very slight, not over four feet to the mile to the northward, all the reentrant angles, formed in a retreating Clinton limestone escarpment, look as if they had been formed by up-stream cutting action of southward-flowing streams. Note on the accompanying map not only the major northeastern reentrant of the Big and Little Miami rivers combined, but also the minor reentrants of the tributaries to the Big Miami from the northwest—those of Four Mile, Seven Mile, Twin and Stillwater Creeks, and that of the upper Miami itself. This Clinton escarpment only here and there peeps out from under its heavy mantle of glacial drift. Evidently there has been no retreat of these escarpments since the glaciers themselves retreated. The veneering of glacial drift has stereotyped this preglacial topography. It is true that geological boundary reentrants

may point down stream. South of the Ohio, one is seen in the lower course of the Kentucky River—the Trenton—Hudson boundary reentrant. This is accounted for by the average dip of the rocks to the northwest on this slope of the Lexington uplift being 12 feet to the mile, while the fall of the river in the same is only 1.2 feet per mile. In order that the reentrants northwest of the Miami River should have been made by streams in that region having a reversed drainage, the average gradients of these streams could not have been greater than four feet to the mile. Four feet to the mile is about the present southwest fall of the Miami River itself, a much steeper gradient

* For a careful analysis of the first edition see Professor Osgood's review published in the *Bulletin of the American Mathematical Society*, Vol. I. (1894–5), pp. 142–154. Some of the criticisms which appear there apply equally to the present edition.

than the preglacial Miami had, but hardly steeper than the gradients of streams occupying the channels of its present tributaries, whether they flowed north or south.

The accompanying map only shows a portion of the Silurian drainage areas to the north of the Ohio. It might have added force to the above argument, to have shown the drainage from the south as well. It would have been found to present an appearance symmetrical with that from the north. In spite of arguments derived from width-of-channel comparisons, etc., it still looks as if the Ohio River were the parent stream and that its present tributaries, the Miami, the Licking, the Kentucky have never been tributary to anything else, but represent normal lateral stream development.

ARTHUR M. MILLER.
STATE COLLEGE OF KENTUCKY.

A POST-GRADUATE SCHOOL OF BIBLIOGRAPHY.

TO THE EDITOR OF SCIENCE: It will not be difficult for any one familiar with the development of libraries and librarianships in this country to see that we have arrived at a turning-point in their history. The large and even moderate sized libraries are developing and will continue to develop special departments in which acquisition is done by collecting rather than selecting. These departments will need for their care and utilization librarians with special knowledge. The largest libraries will specialize in several departments and consequently will need a staff of reference librarians each a specialist—a 'faculty,' as Mr. Melvil Devey calls it in a very suggestive article in the July number of *The Library*. Lastly, highly specialized libraries, each devoted to some special science or group of sciences, will grow up.

This development will necessitate some very radical changes in the class of men who will take up library work, and consequently in the provision for the education of librarians. We shall see men with university education taking responsible positions in libraries instead of seeking university professorships, and the demands of such men for opportunities to prepare themselves for their life-work without having to go back to the college or even high-school grade must be met. It cannot be met by the present library schools as now constituted. The work these schools are doing in preparing young men and women for subordinate positions in popular libraries is an absolutely necessary one and one that must not be slighted. In addition to these we need special schools for the education of scientific librarians and bibliographers. Perhaps one or the other of the library schools can develop a school of this grade. However that may be, there should be established at the large universities special schools of bibliography of the same rank as the schools of engineering, commerce and history.

The present writer had occasion to bring this question to the attention of the librarians at the conference of the American Library Association in July of this year, as has already been noticed in SCIENCE. The question is certainly of great importance, not only to librarians, but to the scientific and educational world at large, and the purpose of these lines is to invite a discussion of the ways and means for the establishment of such schools. I hope that SCIENCE will open its columns for this discussion and that educators and scientific men and librarians, too, will take part in it.

A school such as here proposed would naturally be open to any one who would take up the study of bibliography or any of its branches, and not exclusively to prospective librarians. These studies have a fascination of their own, just as literary history, philosophy or mathematics, and are just as capable as any of these sciences of inspiring with enthusiasm the searcher after truth.

The curriculum of a school of bibliography should include the following subjects:

1. The literature of bibliography, with practical exercises in the handling of bibliographical repertories and indexes and in bibliographical compilation.

2. History and methodology of the sciences, and comparative history of literature (literature taken in its broadest sense), including the study of the systems of classification of knowledge and their relations to the schemes for classification of books.

3. History of printing and bookselling, with special emphasis on the invention of printing, and exercises in the cataloguing of incunabula.

4. History of libraries and library administration.

5. Paleography, classical and mediæval; diplomatics; administration of archives.

The studies in the schools of bibliography should lead up to the degree of Doctor of Philosophy as the studies in any other school. To create a special degree in 'library science,' as has been done in the library schools, seems unnecessary.

Aksel G. S. Josephson.

The John Crerar Library,
Chicago, Sept. 7, 1901.

NOTES ON INORGANIC CHEMISTRY.

It has been often claimed that the presence of nickel in dust is a sufficient criterion to distinguish it as being cosmic rather than terrestrial in its origin. Hartley and Ramage have, however, shown in a paper recently read before the Royal Society that nickel is found in soot, and hence that nickeliferous dust may be of terrestrial origin. They also called attention to the wide distribution of gallium in small traces, being found in all aluminous minerals, in many flue dusts, in many iron ores, and in soot and atmospheric dust. A dust is described which is probably of cosmic origin. It fell on a calm night in November, 1897, was magnetic and very uniform in composition, and unlike volcanic dust or the dust of any known terrestrial source.

A continuation of Gautier's work on the rare elements in the crystalline rocks reveals not only the presence of nitrogen and argon, but also iodin and arsenic. Helium was not found. The gases of mineral waters and the gases issuing from the earth's crust into the atmosphere seemed to be formed by the action of water at high temperature upon the nitrids, argonids, carbids, sulphids, arsenids and other accessory constituents of the igneous rocks.

The action of manganese dioxid and other finely-divided substances in facilitating the liberation of oxygen from potassium chlorate at a low temperature, is considered by some to be merely mechanical. After a series of experiments at the Explosives Committee's laboratory at the Royal Arsenal, Woolwich, Sodeau comes to the conclusion "that the supposed ability of chemically inert solid particles to facilitate the decomposition of potassium chlorate is unsupported by experimental evidence, and, if existing, is inadequate to explain even a small fraction of the great facilitation produced by the oxids of manganese, iron, cobalt, nickel, and copper. The action of the latter substances would therefore appear to be entirely chemical."

The discovery, or rather the isolation, of a new element has been announced by M. Demarçay, in the *Comptes Rendus*. Some fifteen years ago Sir William Crookes called attention to an anomalous band in the spectrum of samarium, which he attributed to a hypothetical meta-element which he called S^{δ}. A few years later De Boisbaudran described a series of lines in the spark spectrum of samarium, and called the element which he supposed their cause Z^{ζ}. The element causing the band and the lines has now been isolated by Demarçay and named *Europium*. It has an atomic weight of about 151, and in its properties lies between gadolinium and samarium.

A new and interesting case of isomorphism is noted by Guthier in the *Berichte*, between one of the modifications of potassium tellurate, $K_2TeO_4,2H_2O$, and potassium osmiate $K_2OsO_4,2H_2O$. Mixed solutions of these two salts crystallize out together. This is one of the very few instances in which tellurium shows an analogy with the metals of the eighth group of the periodic system.

A paper has recently appeared in the *Journal de Pharmacie et de Chimie*, by E. Jungfleisch, on the 'Sulfur Industry in Sicily.' The output has increased from 150,000 tons in 1860 to 447,000 tons in 1898. The world's production at these two dates was 157,000 and 488,000 tons, Sicily thus furnishing about 90 per cent. The price during this period has not varied very largely, having been 120 francs in 1860, 142 in 1875, 100 in 1880 and 92 francs a ton in 1898. The amount of sulfur in the ore varies from a very rare richness of 75 per cent. to 20 or 25 per cent. of sulfur in the ordinary ore. A 30-per-cent. ore is considered rich, while ores are worked with as little as 10 or even 8 per cent. Poorer ores than this cannot be worked profit-

ably. The older methods of obtaining sulfur from its ore by setting fire to it in covered heaps or in kilns, where the sulfur itself served as fuel, have been discarded both on account of the waste and because of the intolerable nuisance to which the fumes of the burning sulfur gave rise. Coal is in general used as fuel, although very expensive. Extraction of the sulfur with carbon bisulfid or with a concentrated solution of calcium chlorid is in many cases used, but the only method in which no noxious fumes are generated is the extraction with steam under pressure. The extent of the industry is rapidly increasing and Sicily will long continue to supply the major part of the world's production.

The use of sulfur as a fungicide is rapidly increasing in the continental vineyards, and for this purpose it is necessary that the sulfur shall be in the most finely divided condition possible. Flowers of sulfur were at first used, and then ground and sifted refined sulfur, but a large portion of even this was wasted on account of the size of the particles. 'Blown' sulfur (*zolfo ventilato*) has lately come into extensive use. The finely ground sulfur is carried by an endless chain into a strong current of air, or for the purpose of avoiding explosions, of gases as free as possible from oxygen. The sulfur dust is carried into large settling chambers where all the larger particles are separated by their more rapid deposition. The sulfur dust thus obtained is pale yellow, resembling precipitated sulfur, and is found to be very satisfactory for fungicidal purposes.

J. L. H.

CURRENT NOTES ON PHYSIOGRAPHY.

PHYSIOGRAPHIC GEOLOGY.

THE increasing recognition of physiography as related to geology is illustrated in Brigham's excellent contribution to the Twentieth Century series ('A Text-book of Geology,' New York, Appleton, 1901, pp. 477, many illustrations). A chapter of forty pages in the middle of the book, devoted to 'Physiographic Structures,' presents a compact epitome of the subject, including a consideration of forms as the result of processes, with a brief exposition of the cycle of erosion and development of drainage. On the other hand, physiographic discipline is not likely to be gained in forty pages, as appears from the scanty treatment of so important a matter as the adjustment of drainage (284–), the explanation of which, as here given, can hardly be appreciated by those who do not already understand it. It may be questioned whether the categorical method of separating folded structures (223–) from the origin and form of folded mountains (256–) is as effective a method of presenting the real earth to beginners as would be found in a closer connection of these naturally associated facts. The same may be said of volcanic processes (135–) and volcanic topography (262–), and of glacial processes (91–) and glacial topography (266–). There may be abundant precedent for the categorical arrangement, and some justification for it in teaching; but a more natural method would bring process and form closer together.

GLACIAL LAKES IN MINNESOTA.

WINCHELL summarizes the history of twenty-six 'Glacial Lakes in Minnesota' (*Bull. Geol. Soc. Amer.*, XII., 1901, 109–128, map), whose geographical consequences are seen in gravel and silt deposits, shore lines and especially in outlet channels. The lake waters were held up by the retreating ice lobes of the Superior and Red river troughs. The most famous of them is Lake Agassiz, so fully described by Upham (Monogr. XXV., U. S. Geol. Surv.). The others were much smaller, and their outlines are at present but imperfectly traced. The outlet channels are of moderate depths, but are usually well defined by banks carved in till; the channel floors are sometimes without streams, sometimes occupied by small streams, sometimes partly covered with shallow ponds or sloughs. The fuller details of this complicated lake system will afford material for local studies for years to come.

ESKER LAKES IN INDIANA.

DRYER, who has already described the 'morainic lakes of Indiana' ('Studies in Indiana Geography,' Terre Haute, 1897, 53–60), now gives an account of 'certain peculiar eskers and esker lakes of northeastern Indiana,' (*Journ. Geol.*, IX., 1901, 123–129, 2 maps). The region concerned is traversed by a series of massive

moraines, the joint product of the Erie and Saginaw lobes of the Laurentide ice sheet. Unusual features abound. "Half-filled valleys and abnormal drainage lines, isolated knobs and morainic outliers, clusters and chains of lakes, kettles and kames conspire with esker-like ridges to produce a type of topography and scenery which seems artificial and almost bizarre." Two of these lakes, High and Gordy's, owe their existence and outline to the presence of eskers, whose origin is ascribed to deposition in tunnels or crevasses in the wasting ice sheet.

THE ONTARIO COAST.

THE Ontario coast between Fairhaven and Sodus bays (near Oswego, N. Y.) is described by J. O. Martin, of Cornell (*Amer. Geol.*, XXVII., 1901, 331–334), as consisting of truncated drumlins connected by stony beaches which enclose bays and marshes. Active 'long-shore movement was noted when waves came obliquely on the shore; a cobble weighing seven ounces was moved sixteen yards in ten minutes by waves whose breaking height was a foot. The recession of the shore line is rapid, in some cases several feet a year. The farmers know this, as they have to set back their shore fences from time to time. Several submerged boulder pavements, having the outline of drumlins but standing at a considerable distance off shore, seem to indicate former drumlins now swept away.

GLACIAL CORRIES IN THE CARPATHIANS.

RECALLING a recent note on corries in the Bighorn Mountains of Wyoming, reference may be made to de Martonne's studies of similar forms in the Carpathians ('Sur la Formation des Cirques,' *Ann. de Géogr.*, X., 1901, 10–16. See also *Bull. Soc. Géol. France*, XXVIII., 1900, 275–319, and *Bull. Soc. Sci. Bucharest-Roumanie*, IX., 1900, No. 4). After a careful study of several examples, this author concludes not only that cirques or corries are certainly of glacial origin, but that they are as safe indication of glacial action as moraines, striations and rounded rocks; that they are of longer duration than the latter, and hence of greater value for the detection of somewhat remote glacial periods; and that they give definite indications of the character of the glaciation by which they were produced, being due to glaciers of the Pyrenean type, and not to a general nor to a local ice sheet. High mountains may thus owe a significant share of their form to glaciation, although whether de Martonne would go as far in this direction as Richter has (see SCIENCE, April 5, 1901) does not appear.

W. M. DAVIS.

SHORTER ARTICLES.

DEFINITIONS OF PHYSICAL QUANTITIES.

THE standards of 'scholarship' must be essentially alike in all branches of knowledge, although differences in detail will show themselves according to the subject. I suppose that the attainment of these standards in the physics of to-day must include accuracy in conceiving fundamental quantities and their connection with each other. Within the past half century much careful thought has been devoted to gaining such clear conceptions and constructing a framework of relation among them. In proportion as the younger physicists inherit the results of that thought undiminished, they will themselves be trained for discriminating and exact thinking. It is therefore a matter of regret that some of our leading authorities are habitually lax in presenting certain definitions that are built into the foundations of mathematical physics. I refer particularly to deliberate statements found in text-books of great general excellence. These are fair marks for criticism, because they must aim at consistent and systematic exposition, and because they influence strongly minds that are in the formative stage. Their example should not encourage a student to confound ideas that are really distinct, nor to tolerate inaccuracy in himself. This can be said without implying a demand for pedantic nicety in writing for experts, who are able to catch the right cue, even from an elliptical expression. I shall illustrate my meaning with a few quotations from Professor Thomson's 'Elements of the Mathematical Theory of Electricity,' and from Professor Webster's 'Theory of Electricity and Magnetism.' These are chosen because they are books of acknowledged value; at the present time each may be taken to register high-water mark within its own range. Since they are representative, we are

all concerned that they should everywhere furnish good models.

Let us first take the general law of inverse square, on account of its widespread application. We find the definition of 'Newtonian Forces, the most familiar examples of which are the mutual attractions of the sun and the planets' (Webster, p. 113), followed by the general expression for potential energy in such cases (p. 114). The latter contains no indication of the factor which becomes gravitation constant, or dielectric constant, or permeability factor; yet it has been stated previously (p. 111) that "Potential energy is defined as work. The unit of energy is, therefore, the *erg.*" The medium-factors for electric and magnetic phenomena are introduced later (p. 354), but the gravitation constant is nowhere restored in the developments, so far as I am aware.

The potential function, or potential, is very commonly defined as representing so much work. Thus, "The potential at P is the work done by the electric forces when the unit charge is taken from P to an infinite distance" (Thomson, p. 27). Or we are told that the potential function is obtained as a particular value of the potential energy, when one mass-factor is unity (Webster, p. 144). This is inconsistent with the dimensions of potential as generally accepted, and as given by the authors themselves (Thomson, p. 449; Webster, p. 559). It is consistent, however, with their definition of field as a force. The negative vector-parameter of the potential function is "The strength of the field, that is, the force experienced by a unit of mass, concentrated at the point in question" (Webster, p. 144). "The electric intensity [field] is the force acting on a small body charged with unit positive charge, when placed at this point" (Thomson, p. 13). But the dimensions of field are not those of force. Electromotive force, as difference of potential, is then of course work also; we find this explicitly stated (Thomson, p. 282; Webster, p. 333). Current, again, is work as well. "$W = 4\pi i$. Thus the work [W] done on unit pole, when it travels round a closed curve, * * * is equal to $4\pi i$, if i is the strength of the current" (Thomson, p. 325). Professor Webster gives this in the form $\Omega = I\omega$ (p. 413). Here Ω is magnetic potential, I current and ω solid angle.

The clue to all these confusions (except the first) is the same elementary consideration. There is a failure to distinguish, in the context and in set terms, between a numerical equality, and a 'physical equation' in which the quantities equated are of the same dimensions. But a sense of such differences must be cultivated, as a part of correct physical thought; although they may be ignored sometimes for the immediate purposes of the mathematician or of numerical determinations in the laboratory. It is probable that repeated contact with statements like those cited dulls our first impression of the contradictions in them. In order to restore its vividness, we need only to construct parallel instances, with which custom has not familiarized us. Thus, density is mass; that is, the mass of a unit volume. In a similar (numerical) sense, force, or momentum, or kinetic energy is mass in special cases. I have pointed out elsewhere ('Principles of Mechanics,' p. 242) that the true dimensional relations for the electrical quantities can be preserved very simply by defining field and potential, respectively, as force and work *per* unit (in the body affected) of the measured quality that is subject to the influences of the particular field. There is no unclearness if the (dimensional) division is indicated by this verbal device or its equivalent.

F. SLATE.

UNIVERSITY OF CALIFORNIA.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THERE is not much to add to the information we gave last week in regard to the Glasgow meeting of the British Association. The president of the Association was directed to write a letter to the American embassy in the name of the Association, containing expressions of regret on the death of President McKinley.

The attendance was 1,912, distributed among the different classes as follows: 310 old life members, 37 new life members, 374 old annual members, 131 new annual members, 794 associates, 246 ladies and 20 foreign members. This is a smaller attendance than at the previous

Glasgow meetings of 1855 and 1876, the Glasgow Exposition and the previous meeting of the International Engineering Congress having apparently interfered with the number of new annual members and associates.

The following grants for scientific purposes amounting to £1,000 were made:

Mathematics and Physics.—Electrical standards, £40; seismological observations, £35; investigation of the upper atmosphere by means of kites, £75; magnetic observations at Falmouth, £80.

Chemistry.—Relation between absorption spectra and constitution of organic substances, £20; wave length tables, £5; properties of metals and alloys affected by dissolved gases, £40.

Geology.—Photographs of geological interest, £5; life zones in British carboniferous rocks, £10; exploration of Irish caves, £45.

Zoology.—Table at the Zoological Station, Naples, £100; index generum et specierum animalium, £100; migration of birds, £15; structure of coral reefs of Indian region, £50; compound sascidians of the Clyde area, £25.

Geography.—Terrestrial surface waves, £15.

Economic Science and Statistics.—Legislation regulating women's labor, £30.

Mechanical Science.—Small screw-gauge, £20; resistance of road vehicles to traction, £50.

Anthropology.—Silchester excavation, £5; ethnological survey of Canada, £15; age of stone circles, £30; anthropological teaching, £3; exploration in Crete, £100; anthropometric investigations of native Egyptian soldiers, £15; excavations on the Roman site at Gelligaer, £5.

Physiology.—Changes in hæmoglobin, £15; work of mammalian heart under influence of drugs, £20.

Botany.—Investigations of the cyanophycene, £10; the respiration of plants, £15.

Educational Science.—Reciprocal influence of universities and schools, £5; conditions of health essential to carrying on work in schools, £2.

THE FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Information in regard to the annual meetings of the French Association for the Advancement of Science is not easy to obtain. The secretaries do not answer letters addressed to them, and the French journals contain very inadequate reports of the proceedings. The *Revue Scientifique* does indeed publish annually the address of the president and the reports of the secretary and treasurer. None of the French journals, however, gives the programs and officers, or similar information.

The meeting this year was held at Ajaccio, in the Island of Corsica—the date is not given in any of the French journals at hand—and the president was M. E. T. Hamy, whose address was on 'The Beginnings of Anthropology in France.' The report of the secretary contains practically nothing but a list of the more eminent members who have died during the year, and a list of those on whom prizes and honors have been conferred. The report of the treasurer is the only document that gives us information in regard to the workings of the Association. This bears witness to transactions of considerable magnitude. The permanent funds of the Association amount to about $270,000. They were increased last year by three legacies amounting to $6,500, and two legacies have already been received this year, one of which amounts to $6,000. It seems strange that in France, where comparatively so little is given or bequeathed for public purposes, the French Association has been given a considerable endowment which is continually increased, whereas the American Association receives practically no part of the large sums that are annually given or bequeathed for educational and scientific purposes. It seems almost certain that if those who give money understand the needs of our Association, and the fact that the French Association from the income of its invested funds is able to support over fifty researches, the American Association will soon be placed in the same condition. As regards current income from the members and its relation to the expenses, the American Association compares favorably with that of France. Though the French Association carries on its books a very large number of members, many of them apparently do not pay the annual fees, for the total receipts are only $9,000, whereas the expenses of administration and publication are over $10,000, and the cost of the meeting last year was $3,000. For this meeting the City of Paris made a special subsidy.

Among the researches for which the largest appropriations have been made are: M. Turpan, for work on Hertzian waves; M. Cheval-

lier, for the publication of his botanical researches in Africa; M. Turquan, for the publication of his work on statistics; Abbe Breuil, for paleontological researches in l'Aisne; M. Cartailhac, for prehistoric researches in Sardinia; M. Chantre, towards the publication of his work on quaternary man in the Valley of the Upper Rhône; the Paris School of Anthropology, for researches on the antiquity of man; MM. Fournier and Repelin, towards the publication of their explorations in Provençe; M. Gentil, for excavations in Algeria; and M. Rivière, for researches in the caves of Mouthe.

SCIENTIFIC NOTES AND NEWS.

PROFESSOR WOLCOTT GIBBS has been appointed one of the five official representatives of Harvard University at the bi-centennial exercises of Yale University.

DR. CARROLL D. WRIGHT, U. S. Commissioner of Labor, has been elected a member of the Paris Institute of Sociology.

WILLIAM JAMES, professor of philosophy, George Lincoln Goodale, professor of natural history and director of the Botanical Garden, and Maxime Bôcher, assistant professor of mathematics, have returned to their work at Harvard after a year's leave of absence spent abroad. We regret to learn that the health of Dr. B. O. Peirce, professor of mathematics and natural philosophy, is such that it has been necessary to extend his leave of absence.

MR. FRANK B. LITTELL, of the U. S. Naval Observatory, has been appointed a professor of mathematics in the navy.

PROFESSOR H. W. CONN, of Wesleyan University, has been appointed lecturer on agricultural bacteriology at the Connecticut Agricultural College, and has been put in charge of dairy experimentation at the Storrs Experiment Station. The experimental work is to be done partly at Storrs and partly in the biological laboratory at Wesleyan University.

DR. DAVID T. DAY, chief of the department of mines and metallurgy in the St. Louis Exposition, has added these experts to the department: Professor J. A. Holmes, state geologist of North Carolina; George F. Kunz, gem expert, with Tiffany & Co., New York City; John Birkinbine, president of the Franklin Institute, Philadelphia; E. W. Parker, editor of the *Engineering and Mining Journal*, New York City; Jefferson Middleton, geological survey, Washington, D. C., clay expert; and Charles C. Yale, Mint Bureau, San Francisco.

WE learn from *Nature* that owing to losses in the staff by death and retirement, the following appointments have been made on the Geological Survey of the United Kingdom: Dr. J. S. Flett has been selected to assist in the petrographical work of the Survey, Mr. J. Allen Howe and Mr. H. H. Thomas have been appointed geologists on the English staff, Mr. H. B. Muff on the Scottish staff and Mr. W. B. Wright on the Irish staff.

PROFESSOR W. H. HOLMES, of the U. S. National Museum, has gone to Indian Territory to make collections of Indian remains.

MR. CLOUD RUTTER, scientific assistant of the U. S. Fish Commission, is on the Pacific Coast for the purpose of gathering salmon statistics, with headquarters on the Sacramento River near Rio Vista.

MR. S. W. LOPER, curator of the museum of Wesleyan University, spent the greater part of the summer in the study of the Cambrian formation of Cape Breton Island for the United States Geological Survey. Mr. Loper made a large collection of fossils.

IT is reported that Mr. H. DeWindt and Mr. George Harding will make a third attempt to accomplish an overland journey via Bering Straits between Europe and America.

THE steamship *Windward* has arrived at Newfoundland bringing Mr. Robert Stein, of Washington, and Mr. Samuel Warmbath, of Boston. The *Windward* will return next summer for Lieutenant Peary.

A TELEGRAPH from Alice Springs on July 19 states that Professor Baldwin Spencer's expedition had finished its work at Barrow Creek, where six weeks had been spent among the Kaitish and Ummatjera tribes. The next main camp was to be formed at Tennant's Creek, about 150 miles further north.

A GRANITE monument in memory of James Bowman Lindsay, an investigator and an in-

ventor who fifty years ago made experiments in connection with wireless telegraphy, was unveiled on, September 14, at Dundee, Scotland, by Sir William Preece.

We regret to learn that Edward W. Claypole, professor of geology at Throop Institute, Pasadena, Cal., died quite suddenly at Long Beach, Cal., on August 17, aged sixty-six years. Professor Claypole was an Englishman and had degrees of A.B. and Sc.D. from the University of London. He came to this country in 1872 and through the influence of Rev. Ed. Everett Hale, was appointed professor of natural science at Antioch College, Ohio, where he served until 1881. He was paleontologist to the second Geological Survey of Pennsylvania for two years and professor of geology at Buchtel College, Ohio, from 1883 to 1897, when he sought the milder climate of Southern California in the interest of his wife's frail health. Dr. Claypole was a geologist noted on two continents. He was a fellow of the Geological Societies of London, Edinburgh and America, and a fellow of the American Association, having served at different times as both section president and secretary of geology. He had published 'The Lake Age in Ohio' and was a frequent contributor to American and foreign scientific journals.

Dr. Abram Litton, who for fifty years filled the chair of chemistry both at Washington University and the St. Louis Medical College, died at his home in St. Louis on September 22 aged eighty seven years.

The position of assistant pomologist in the Bureau of Plant Industry of the Department of Agriculture will be filled as the result of a civil service examination on November 2. The examination is entirely on the subjects of the office, and applicants are not required to be present at any special place. On October 22, an examination will be held to fill the position of assistant in the Dairying Division of the Bureau of Animal Industry at a salary of $1,200. The examination will be held in any city in the United States where rural free delivery has been established.

The subject of the Fiske Fund Prize Essay ($200) for the year 1902 is 'Serumtherapy in the Light of the Most Recent Investigations.' Further information may be obtained from the secretary of the Board of Trustees of the Fiske Fund, Dr. Halsey DeWolf, 212 Benefit Street, Providence, R. I.

Mr. W. C. Mills, curator of the Ohio State Archeological and Historical Society, has returned to Columbus, Ohio, from a successful season of exploration in various part of Ohio. He excavated the noted Adena Mound, situated in sight of Chillicothe and perhaps the largest mound in the Scioto Valley, being 26 feet high and 445 feet in circumference. The mound contained about 6,000 cubic yards, all of which was turned over and examined. Thirty-two skeletons with many implements and ornaments were found. One specimen is a very fine carving about 8 in. long, representing the human figure. In execution it is not surpassed by any of the objects found in mounds in the Scioto Valley.

The German Mathematical Society held its annual meeting from September 22d to 28th at Hamburg in affiliation with the Congress of German Men of Science and Physicians. Twenty-one papers are to be found on the program issued in advance of the meeting, and it is stated that the Society would consider the publication of a monthly journal in the place of the present *Jahresbericht*.

We learn from the London *Times* that the Congress of the International Association for Testing Materials was held at Budapest, from September 9 to 14, under the presidency of Professor L. von Tetmajer, and was largely attended by engineers from all parts of the world. The delegates present included four from England, 41 from Austria, three from Belgium, nine from Denmark, two from the United States, 36 from France, 152 from Hungary, 70 from Germany, three from Norway, 12 from Italy, 26 from Russia, one from Roumania, three from Spain, one from Servia, ten from Switzerland and five from Sweden. After an inaugural presidential address and address of welcome from the Hungarian authorities, a representative of each country was elected an honorary president of the congress, Mr. Bennett H. Brough being chosen for England, and Professor H. M. Howe for the United States.

The other English and American members present were: Sir William H. Bailey (Manchester), Mr. Bertram Blount (London), Dr. C. J. Renshaw (Ashton-on-Mersey), and Dr. R. Moldenke (New York). In addition to the various reports of committees dealing with technical problems, the following papers dealing with metals were read and discussed: 'On the Measurement of Internal Tension,' by Mr. Mesnager (Paris); 'On the Forms of Carbon in Iron,' by Baron Jüptner (Leoben); 'On Brinell's Researches,' by Mr. A. Wahlberg (Stockholm); 'On the Testing of Metals by Means of Notched Bars,' by M. H. Le Chatelier (Paris), by M. G. Charpy (Paris), and by Professor Belelubsky (St. Petersburg); 'On Micrographical Researches on the Deformation of Metals,' by Mr. F. Osmond (Paris); 'On Metallography,' by Mr. E. Heyn (Charlottenberg); 'On the Testing of Railway Material,' by Mr. E. Vanderheym (Lyons); and 'On the International Iron and Steel Laboratory,' by Professor H. Wedding (Berlin). Several papers dealing with stone and mortars were also read, and an interesting lecture on the iron industry of Hungary was delivered by Professor Edvi-Illes (Budapest).

IT is now said that the German government has authorized the purchase of the astronomical instruments originally taken from Pekin by the German soldiers.

IN addition to the *Lucania*, three other steamships of the Cunard Line—the *Campania*, the *Umbria* and the *Etruria*—will be fitted with Marconi's system of wireless telegraphy.

CONSUL HAYNES, of Rouen, under date of August 26, 1901, says that the metric system is compulsory in twenty countries, representing more than 300,000,000 inhabitants—Germany, Austria-Hungary, Belgium, Spain, France, Greece, Italy, Netherlands, Portugal, Roumania, Servia, Norway, Sweden, Switzerland, Argentine Republic, Brazil, Chile, Mexico, Peru, and Venezuela—and advises American exporters in dealing with any of these countries to adopt the system.

WE learn from the *Electrical World* that the International Statistical Institute will hold this year in Budapest, from September 20 until October 5, an international exhibit of all kinds of machines and instruments which facilitate work with figures. The aim of the exhibit is to furnish to the most competent representatives of scientific and practical statistics assembled from different parts of the world the opportunity of gathering personal information about this kind of technical construction. The exhibit will include all kinds of inventions, engines and apparatus which are intended to facilitate work with figures in general, and especially those which are devised to facilitate the compilation of statistical data and to perform the necessary proportional calculations, and to accelerate and render more economical statistical labor; especially machines for adding, multiplying, dividing, tabulators, accounting machines for the combined compilation of data, etc.

IT is announced that a commission, to be presided over by Sir Colin Scott-Moncrieff, is being appointed to lay down rules for control of irrigation works in India. In connection with this announcement the London *Times* quotes figures given in the annual review of irrigation issued recently in India. From them it appears that 22 of the large productive works realized a net revenue amounting to 9.52 per cent. on the capital outlay, while 13 others yielded only 0.79 per cent., reducing the average return to 7 per cent. The total area of the crops irrigated or protected exceeded 18½ millions of acres, being an increase of over three quarters of a million during the year. The principal enhancements were in respect to the Punjab canals, the area irrigated there exceeding all previous records by over 300,000 acres, while the net return on capital in respect to that province was as high as 10.24 per cent. Still more gratifying results may be looked for in the current year, since the great Jehlum Canal, begun in the autumn of 1898, is to be formally opened in October, and will irrigate a vast tract of country lying between the Chenab and Jehlum rivers, a great portion of which has hitherto lain waste. Other large projects are being carried out in the Punjab, and will, when ready, be worked on the lines so successfully adopted in the case of the Chenab colonies. The total surplus revenue earned since irrigation works were undertaken by government has been nearly ten millions

sterling. This is the purely financial result of irrigation, regarded as an investment, and the figure quoted has no reference to its economic value in increasing food supplies, in preventing famine, and in strengthening the position of the owners and occupiers of the land. Neither does it take into account the increase of land revenue received by the State, as a result of bringing waste tracts under cultivation.

UNIVERSITY AND EDUCATIONAL NEWS.

THE Severance Chemical Laboratory of Oberlin College was dedicated on September 26, the address being made by President Ira Remsen, of the Johns Hopkins University. At the conclusion of the dedicatory exercises it was announced that Mr. Lewis Severance, of New York City, the donor of the laboratory, had given the sum of $40,000 for an endowment for the chair of chemistry.

THE University of Southern California at Los Angeles has obtained the $100,000, of which $25,000 was offered by Mrs. Anna Hough on condition that the balance be given. Mrs. Hough has now offered $40,000 towards a second $100,000.

BY the will of the late Mrs. Martha Callahan, $20,000 is bequeathed to Tuskegee Normal and Industrial Institute of Tuskegee, Ala.

PROFESSOR GOLDWIN SMITH has given $10,000 to the library of the University of Toronto.

AT a recent meeting of the corporation of Yale University it was decided that the house which Professor O. C. Marsh bequeathed to the University and which is now occupied by the Forest School shall be known officially as Marsh Hall, and the grounds about it as the Yale Botanical Garden.

AT the spring meeting of the trustees of Colby College, Waterville, Me., the department of geology was abolished, and it was decided that henceforth the teaching of geology should be by the assistant in chemistry. The determination was taken suddenly, the reason assigned for the action being purely a financial one. The abolition of the department necessarily legislates Dr. W. S. Bayley from the position which he has held during the past twelve years.

DR. STURGIS, of the Connecticut Agricultural Experiment Station, Professor Brinton, the State entomologist, and Professor Hopkins, of West Virginia University, have been appointed special lecturers in the Yale Forest School.

MR. EUGENE L. LEHNERT, of Clinton, Mass., has been elected professor of veterinary medicine at the Agricultural College at Storrs.

AT the Western Reserve University, Dr. F. W. Reichmann, of the University of Chicago, has been appointed instructor in physics; Dr. O. F. Tower has been promoted to be associate professor of chemistry.

DR. CHARLES M. HAZEN has been appointed professor of biology in Richmond College, at Richmond, Va.

THE following appointments have been made at the Illinois College, Jacksonville, Ill.: J. Bishop Tingle, Ph.D. (Munich), instructor of chemistry at the Lewis Institute, Chicago, to be professor of chemistry. J. B. Overton, Ph.D. (Chicago), graduate assistant in botany in the University of Chicago, to be professor of biology. J. H. Hall, Ph.D. (Yale), assistant in the University of Chicago, to be assistant professor of physics.

MISS S. M. HALLOWELL, professor of botany at Wellesley College, has been given leave of absence for the year and the work of the department will be under Miss Clara E. Cummings, assistant professor of botany.

EDWARD C. SCHNEIDER, Ph.D. (Yale, 1901), has been been appointed to take charge of the work in biology at Tabor College, Tabor, Iowa.

MR. R. M. FERRIER, B.Sc. (Glasgow), M.Sc. (Durham), has been appointed to the chair of engineering at University College, Bristol, in succession to Dr. Stanton, who has received the appointment of superintendent of the engineering department in the National Physical Laboratory.

DR. ROKURO NAKASEKO, who has been the recipient of a University Fellowship at Yale during the past two years, has returned to Kyoto, Japan, to take charge of the instruction in physiological chemistry in the Scientific School there.